

90-15.

**Ransome System**  
**Concrete = Cold Twisted Steel**  
**Construction**

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721.9  
*Reinforced Concrete*

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**Ransome Construction Company**  
**Harrison Building**  
**15th and Market Streets      Philadelphia, Pa.**







RANSOME SYSTEM  
CONCRETE - COLD TWISTED STEEL  
CONSTRUCTION.

FOR  
FIREPROOF BEAMS, GIRDERS, COLUMNS, FLOORS,  
WALLS, STAIRS, VAULT LIGHTS, ETC.

SEWERS, WATER CONDUITS, RESERVOIRS,  
TUNNELS, SUBWAYS, ETC.

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RANSOME CONSTRUCTION COMPANY,  
HARRISON BUILDING,

15TH AND MARKET STREETS, PHILADELPHIA, PA.

(C-1905)



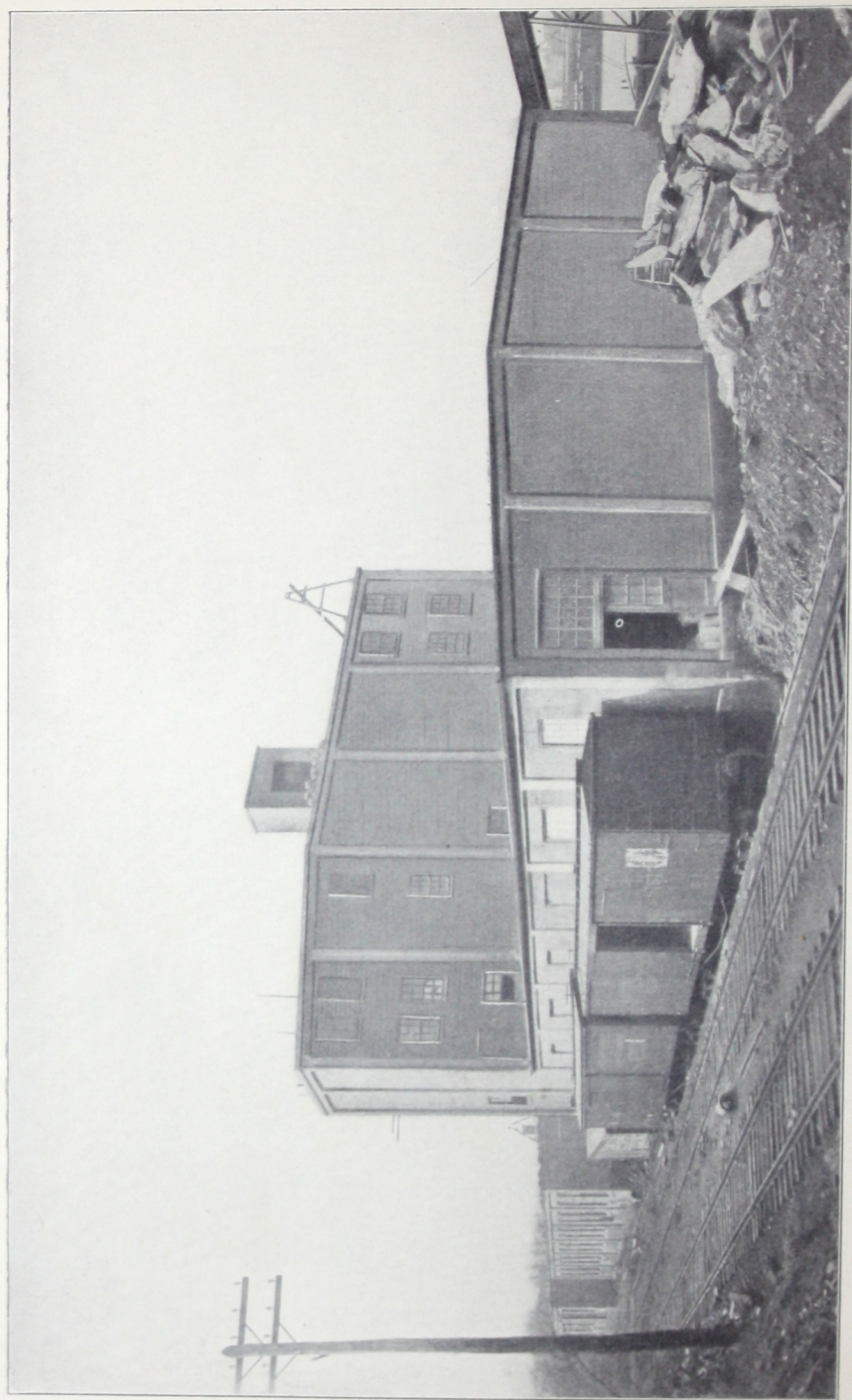


PLATE I. PLASTER MILLS, J. B. KING & Co., NEW BRIGHTON, STATEN ISLAND.  
Built entirely of Concrete Cold Twisted Steel.



## CONCRETE-STEEL CONSTRUCTION.

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CONCRETE is not a new building material. It has been used for centuries for foundations, walls and heavy structures where great strength was required. The dome of the Pantheon in Rome, 142 feet in diameter, was built entirely of concrete and stands to day, nearly 2000 years old, as an example of the durability of concrete.

The Aqueduct of Vejus built by the Romans is another example. There are buildings in Mexico, the remains of an unknown civilization which have concrete foundations.

The rapid growth of concrete construction in the past few years has been due largely to the improvements made in the manufacture of Portland Cement and to the consequent reduction in its cost and also to the better appreciation and understanding by architects and engineers of the merits of concrete for fire-proof and general building construction. Another very important factor in the rapid extension of concrete construction was the discovery that concrete and steel could be combined in such manner as to add largely to the good qualities of both, one augmenting or supplementing the other.

It was known that concrete would resist very heavy crushing loads but would fail quickly and suddenly when subjected to tension. The



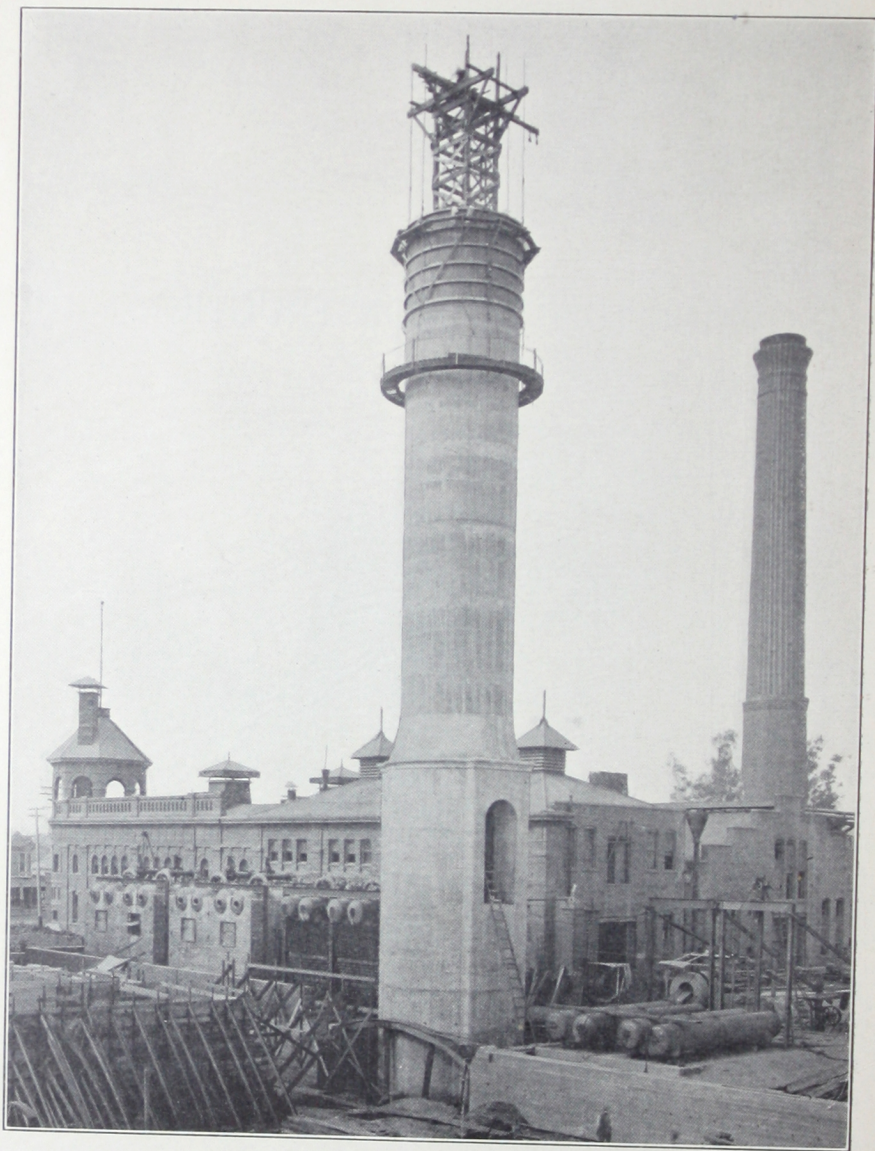


PLATE II. CONCRETE CHIMNEY, RANSOME SYSTEM.

Height, above grade, 155'. Internal diameter, 11' 0".

Built for Los Angeles Railway Co., by C. Leonardt, Los Angeles, Cal.



problem therefor was to incorporate in the concrete a material that would give the requisite tensile strength and at the same time act in unison with it under service conditions.

One naturally turned to steel for this material and it was found by experiments that the two materials would act as a composite structure, the steel taking the tension and the concrete the compression. It was also found that the expansion and the contraction of the two materials under temperature changes were practically the same, removing the possibility of any injury resulting from the effects of heat.

The limitations to the economical application of concrete to all classes of engineering work were thus removed and concrete-steel immediately became recognized as a valuable new building material.

Few stones can be classed as good building material. They either weather poorly or will not withstand the action of fire and water. Granite has great strength and will withstand the action of the weather but will explode under the combined action of heat and water. Lime stone will carbonate and is therefore a poor fireproofing material. Brick or burned clay products vary greatly in character and quality and can be used only in walls and partitions or for filling between beams adding merely to the dead weight without giving any additional strength.

Concrete-steel embodies the good qualities of all of these materials as we think any one will admit after a careful study of its advantages.

## DURABILITY.

Portland Cement Concrete correctly proportioned and mixed and thoroughly rammed in tight molds is one of the most durable building materials known. It absorbs very little moisture, has few joints for frost to enter and is not injured by temperature changes or the gases contained in the atmosphere.

It increases in strength and hardness with age. Cement pavements are the best evidence of the ability of concrete to withstand the action of the weather and severe usage. Several large chimneys have been successfully built of concrete-steel proving that even high temperatures



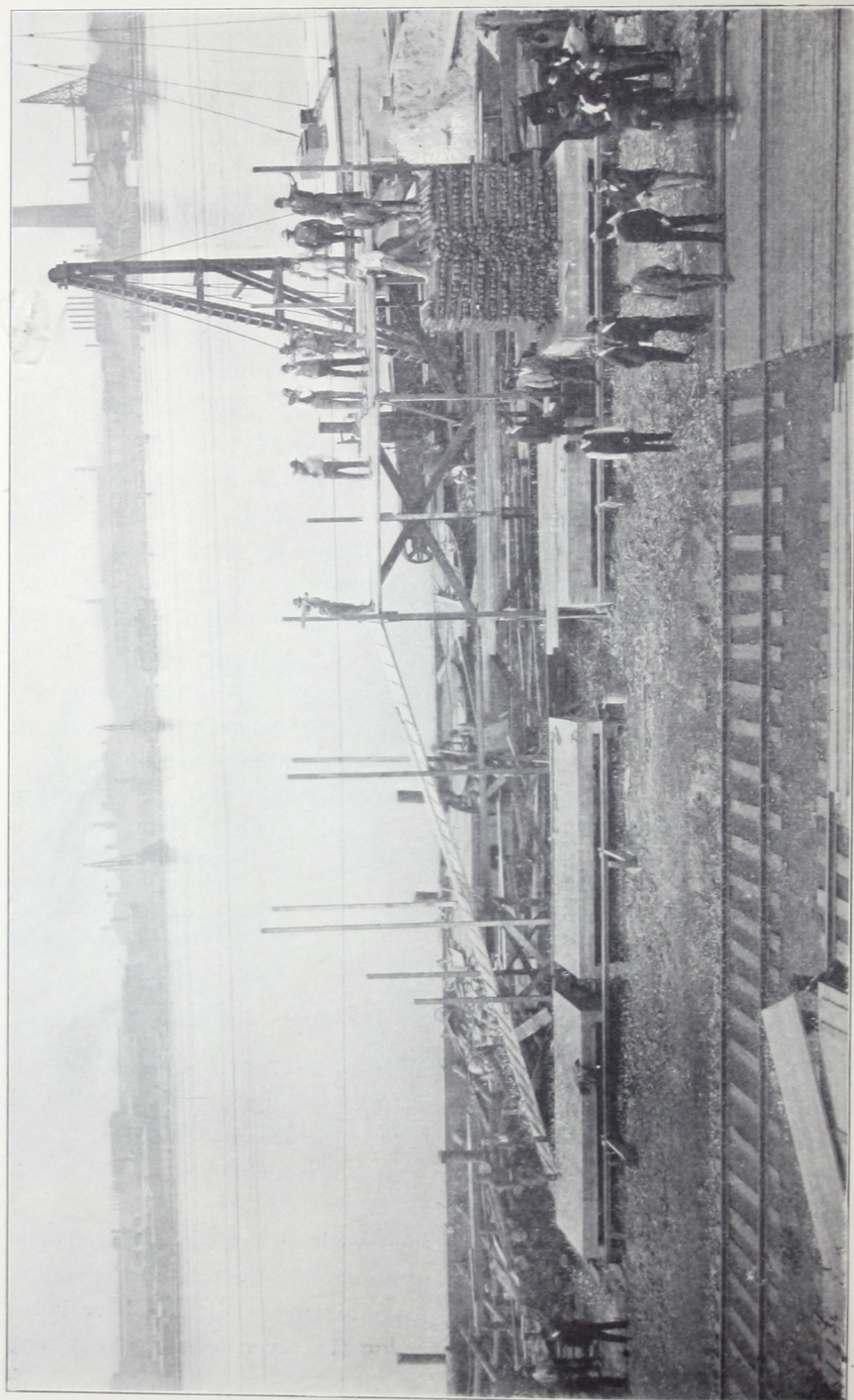


PLATE III. GENERAL VIEW OF TEST SECTION.

Load Tests, Ransome System. Conducted under the direction of Department of Buildings, Borough of Richmond, New York City.



long continued will not injure concrete. Sea walls are another evidence of the permanency of concrete construction.

## STRENGTH.

We give the results of a series of tests made at Watertown Arsenal in 1899 by Mr. George A. Kimball, Chief Engineer of the Boston Elevated R. R., on 12" cubes of concrete without any metal reinforcement. Each is the result of five or more tests. The results are expressed in pounds per square inch.

| PROPORTIONS | AGE    | ATLAS | ALPHA | GERMANIA | ALSF N | MEAN |
|-------------|--------|-------|-------|----------|--------|------|
| 1-2-4       | 7 days | 1387  | 904   | 2219     | 1592   | 1525 |
|             | 1 mo.  | 2428  | 2420  | 2642     | 2269   | 2440 |
|             | 3 "    | 2966  | 3123  | 3082     | 2608   | 2944 |
|             | 6 "    | 3953  | 4411  | 3643     | 3612   | 3904 |
| 1-3-6       | 7 days | 1050  | 892   | 1550     | 1438   | 1232 |
|             | 1 mo.  | 1816  | 2150  | 2174     | 2114   | 2063 |
|             | 3 "    | 2538  | 2355  | 2486     | 2349   | 2432 |
|             | 6 "    | 3170  | 2750  | 2930     | 3026   | 2969 |

The Austrian Society of Engineers and Architects made a number of tests in 1897 on concrete blocks of different mixtures and also on some containing a reinforcement of Monier rods. They stated their conclusions as follows,—“The great influence of iron netting embedded in concrete is shown by the tests of Monier piers. The piers with vertical rods extending from plain of pressure to plain of pressure proved to have a very great resistance and it was not possible to obtain a complete failure of the same.” This characteristic of concrete-steel is of great importance. The embedded steel removes the possibility of sudden or even complete failure.

We also give the results of a number of load tests on floors constructed of concrete reinforced with cold twisted steel bars, known as the Ransome System.

The most extensive tests were those made by Turner Construction





PLATE IV. GRAVEL SECTION 9'2" SPAN, RANSOME SYSTEM.

LOAD TEST, BOROUGH OF RICHMOND, NEW YORK CITY.

Maximum load placed on this Section was 110,218 lbs. equivalent to 4,007 lbs. per square foot producing only  $\frac{1}{16}$  of an inch deflection.



Company, for the Department of Buildings of New York City in September 1902, at New Brighton, Staten Island, to demonstrate to the Department, the strength of the Ransome construction before erecting several buildings of this construction for J. B. King & Co. Plate I shows a general view of these buildings.

Plate III gives a view of the floor sections to be tested. The first two sections at the right had a clear span of 9'2" and were designed for a working load of 600 lbs. per square foot. The two sections at the left had a clear span of 14'6" and were designed for a working load of 50 lbs. per square foot.

One section of each span was constructed of gravel concrete and the other of trap rock concrete. The proportions for all four sections consisted of one part Lehigh Portland Cement, two parts clean sharp sand and four parts of gravel or trap rock. The steel reinforcement consisted of cold twisted steel bars having an elastic limit of about 55,000 lbs. per square inch and an ultimate strength of about 85,000 lbs. per square inch. The construction is shown in figure 1.

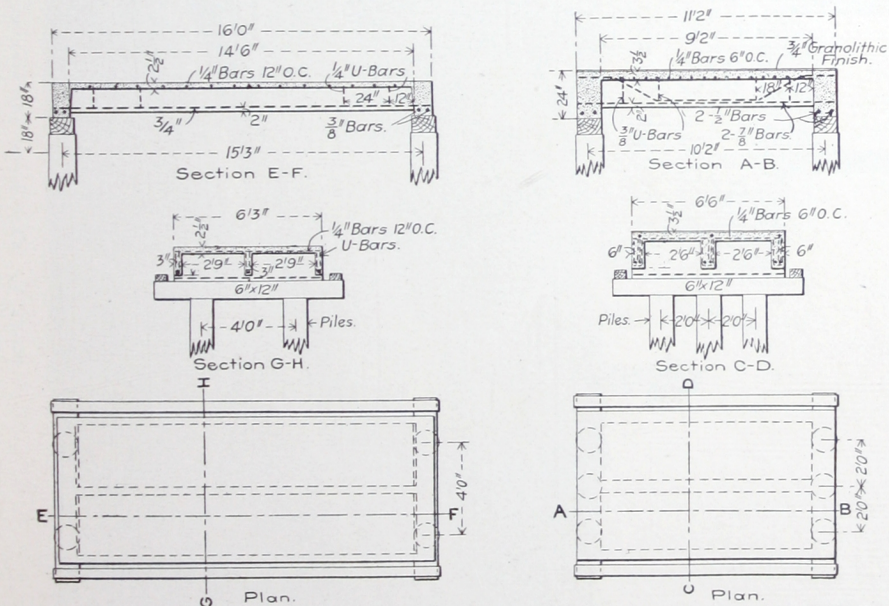


FIGURE 1.



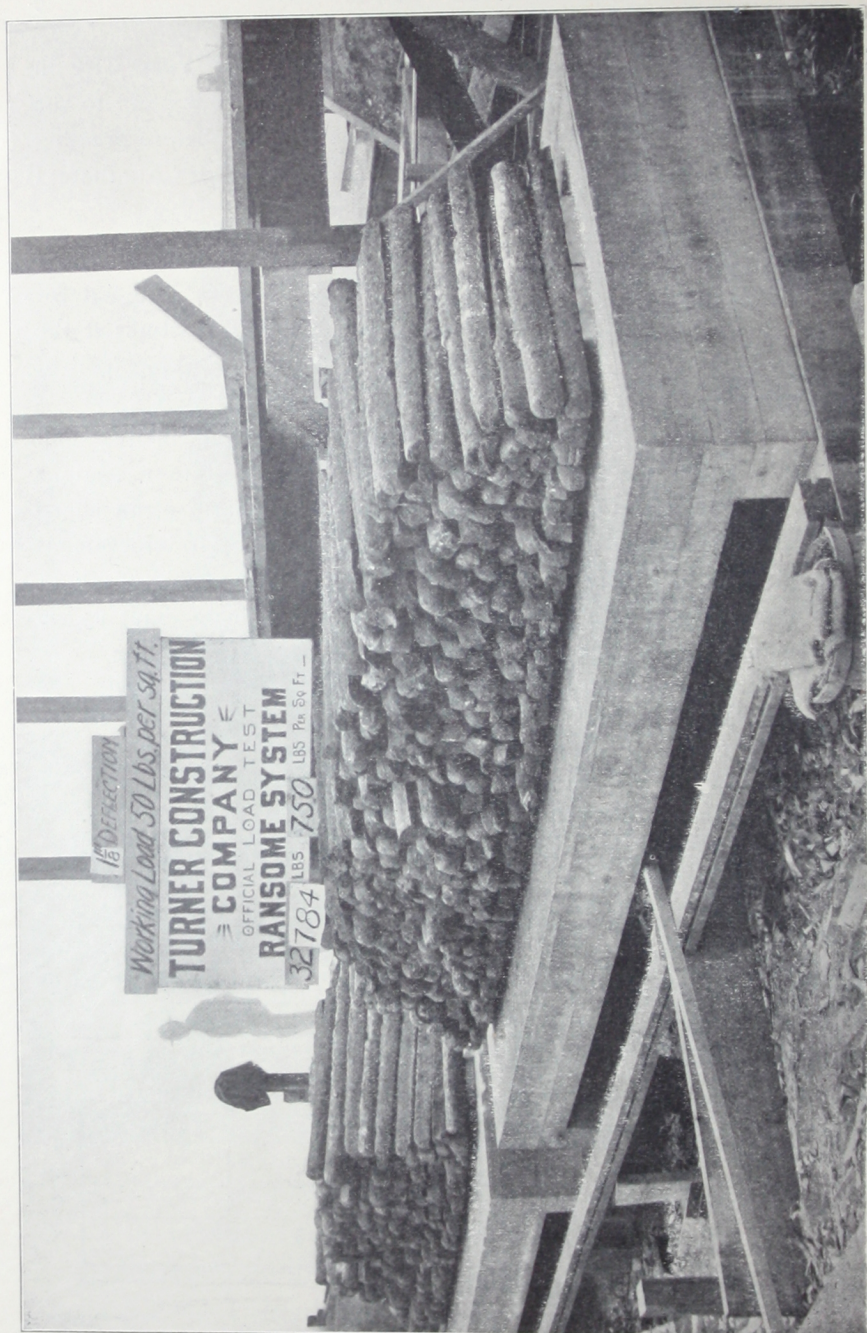


PLATE V. TRAP ROCK AND GRAVEL SECTIONS, 14' 6" SPAN, RAMSOME SYSTEM.

LOAD TESTS. BOROUGH OF RICHMOND, NEW YORK CITY.

Maximum load placed on trap rock section, 753 lbs. per square foot, and on gravel section, 822 lbs. per square foot.



The sections were thirty-four days old when tested. The load was evenly distributed over the middle beam on a width of 2 feet.

Plate IV shows the 9'2" span, of gravel concrete, with a total load of 100,000 lbs. The final load on this section was 110,218 lbs., equivalent to 4,007 lbs. per square foot. The center deflection under this load was only 1/16 of an inch with absolutely no signs of injury. Without doubt this section would have carried a very much greater load without permanent injury and loading was only stopped because of the lack of further loading material. The other 9'2" span was not tested.

Plate V shows the 14'6" spans. It was possible to load these sections until permanently injured. Table 1 gives the loading for the gravel section and table 2 for the trap rock section.

TABLE 1.

LOAD TEST OF 14' 6" SPAN,  
GRAVEL CONCRETE.  
RANSOME SYSTEM.

| TOTAL<br>LOAD<br>LBS. | LOAD PER<br>SQ. FT.<br>LBS. | CENTER<br>DEFLEC-<br>TION |
|-----------------------|-----------------------------|---------------------------|
| 9800                  | 225                         | 1/16"                     |
| 11046                 | 253                         | 2/16"                     |
| 13523                 | 310                         | 3/16"                     |
| 16642                 | 382                         | 5/16"                     |
| 19578                 | 450                         | 6/16"                     |
| 22696                 | 521                         | 7/16"                     |
| 25501                 | 586                         | 9/16"                     |
| 28652                 | 658                         | 12/16"                    |
| 32680                 | 752                         | 15/16"                    |
| 35800                 | 822                         | 21/16"                    |

TABLE 2.

LOAD TEST OF 14' 6" SPAN,  
STONE CONCRETE.  
RANSOME SYSTEM.

| TOTAL<br>LOAD<br>LBS. | LOAD PER<br>SQ. FT.<br>LBS. | CENTER<br>DEFLEC-<br>TION |
|-----------------------|-----------------------------|---------------------------|
| 9559                  | 219                         | 1/16"                     |
| 11228                 | 258                         | 2/16"                     |
| 13900                 | 319                         | 3/16"                     |
| 16528                 | 379                         | 4/16"                     |
| 19879                 | 456                         | 5/16"                     |
| 22925                 | 527                         | 7/16"                     |
| 25477                 | 585                         | 9/16"                     |
| 28756                 | 661                         | 12/16"                    |
| 31097                 | 712                         | 17/16"                    |
| 32784                 | 753                         | 19/16"                    |

The deflections varied directly with the load proving the elasticity of the construction. The first signs of failure were indicated by fine vertical cracks near the center of the beam. These were followed by diagonal shearing cracks about 18" from the supports. At the maximum load the shearing cracks had opened about 1/4 of an inch. It should be



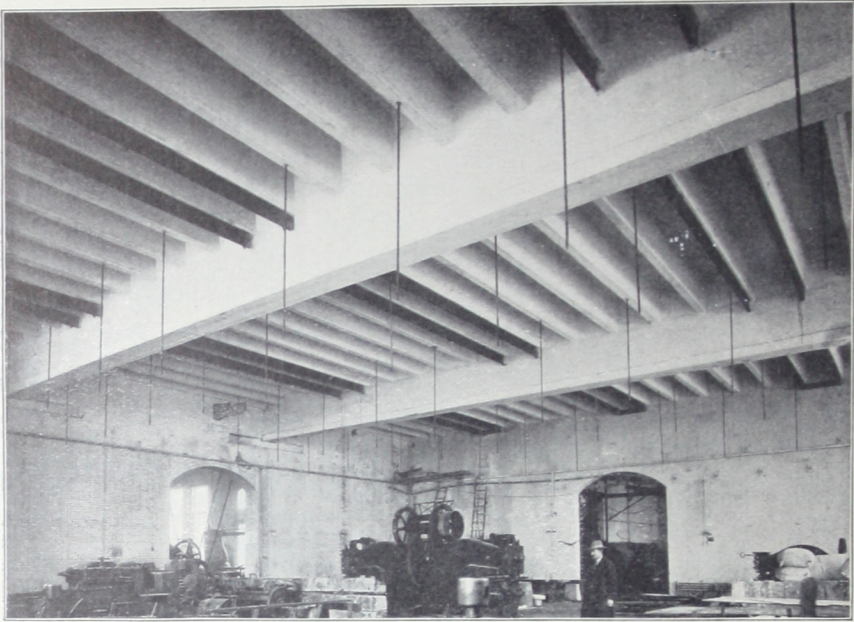


PLATE VI. UNDER SIDE OF FLOOR CONSTRUCTION.  
Ransome Ssystem. Beams, 24' 10" span.

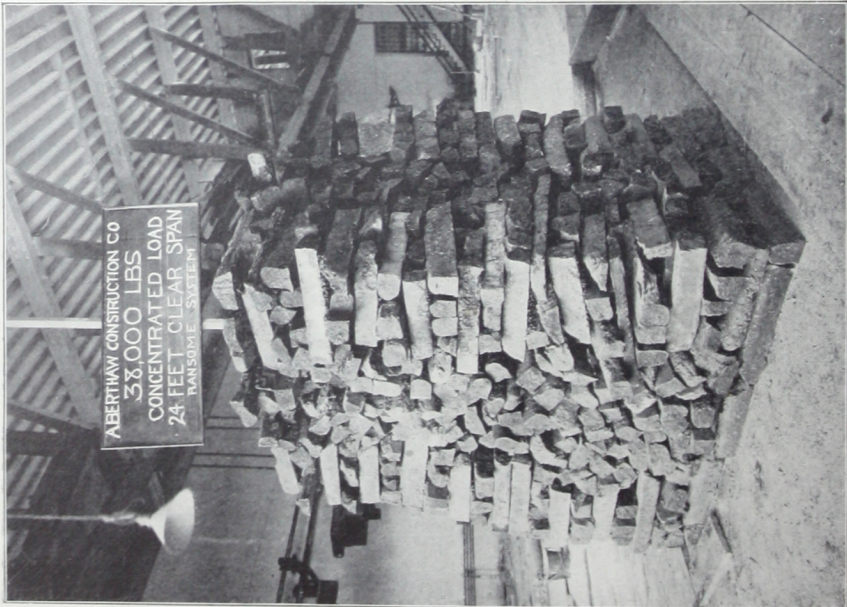


PLATE VII. TEST LOAD, 38,000 LBS. CONCENTRATED.  
NO MEASURABLE DEFLECTION.

FLOOR CONSTRUCTION, PATTERN SHOP, CHARLESTON NAVY YARD.  
Built by Aterthaw Construction Co. of Boston.



observed that under the final loads of 753 lbs. per square foot for the trap rock section and 822 lbs. per square foot for the gravel section, neither section failed completely. In other words floors of the Ransome System give abundant warning of over-loading. They do not fail suddenly, but continue to sustain loads which are sufficient to cause considerable deflection and large cracks in the beams. The tests were accepted by the Building Department and permits issued for the construction of the buildings.

Plate IV gives a view of the under side of the Pattern Shop floor erected by the Aberthaw Construction Company, of Boston, at Charlestown Navy Yard, and Plate VII the test load applied under the direction of the Chief Engineer. The span of the Ransome beams, spaced 3' apart, was 24' 10". The test load concentrated over the center of the span was 38,000 lbs. equivalent to twice the figured live load. This load produced a deflection of  $\frac{1}{16}$  of an inch which disappeared when the load was removed.

Plate VIII illustrates a load test on a flat top sewer of 8' span made for the Department of Public Works of Philadelphia by the Ransome Construction Company, of Philadelphia. The Ransome beams were 2 ft. apart and each contained a  $1\frac{1}{2}$ " square bar cold twisted.

The total load, concentrated over an area of 4 square feet, over the center of one beam was 43,360 lbs. Although this load was more than twice the specified working load for the sewer, and the test made when the concrete was only 20 days old it did not even produce a measurable deflection.

Plate IX illustrates the test load applied to the Ransome floor construction in the Washington County Court House, Marietta, Ohio. The span of the Ransome beams was 25' 10", the figured live load 125 lbs. per square foot. The total test load was 26,880 lbs. applied evenly over one beam equivalent to a load of 600 lbs. per square foot. This load produced a deflection of  $\frac{3}{16}$  of an inch which disappeared when the load was removed.

Floors of the Ramsome System can be calculated with same precision as steel beams. There is no guess work. The many floors which have been erected and are to-day giving absolute satisfaction are sufficient



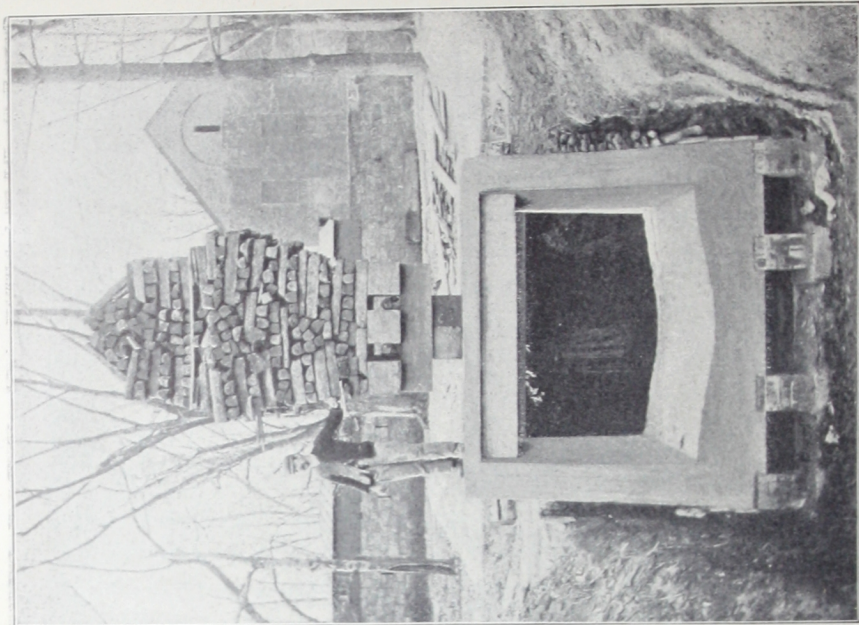


PLATE VIII. TEST SECTION OF SEWER. SPAN, 8 FEET.  
CONCENTRATED LOAD, 43,360 LBS., EQUIVALENT TO  
5,400 LBS. PER SQUARE FOOT.  
Built by Ransome Construction Co., Philadelphia.

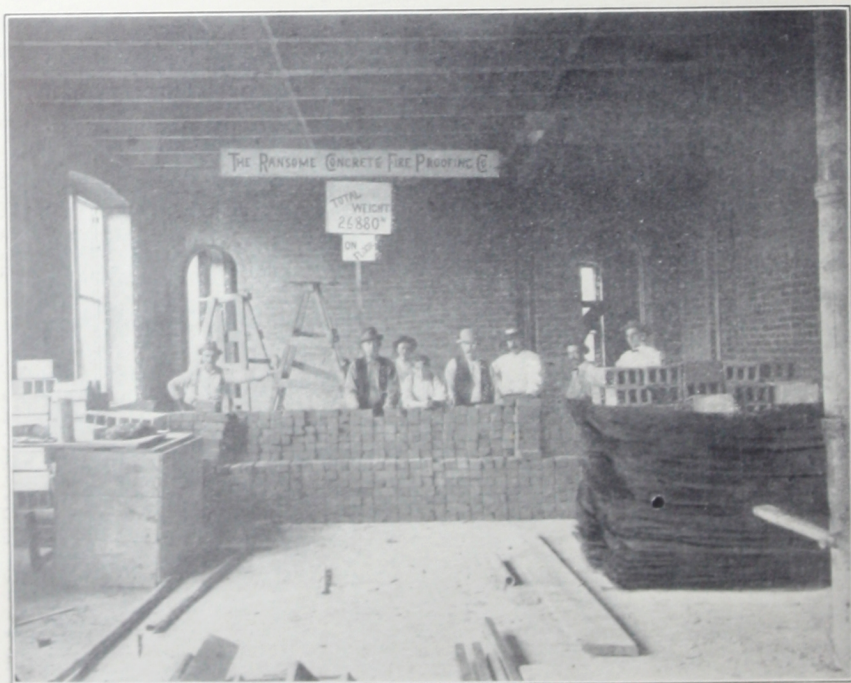


PLATE IX. LOAD TEST, RANSOME FLOORS.  
WASHINGTON COUNTY COURT HOUSE, MARIETTA, OHIO  
Span, 25' 10"; specified live load, 125 lbs. per square foot; test load, 600 lbs. per  
square foot;  $\frac{1}{8}$ " deflection.



proof of the reliability of our methods. It is not scientific to require a factor of safety of 10 for concrete-steel floors because this margin is considered wise in masonry. The steel reinforcement has eliminated the element of weakness in concrete and there is no uncertainty of action to be guarded against by such a large margin of safety. It is our practice to use a factor varying from 4 to 6, depending upon the conditions of loading and usage.

## VIBRATION.

There is no floor construction so free from vibration as concrete-steel. This is because the floors are a monolith of concrete. Heavy or rapid running machinery produces no tremor, a point often commented upon in regard to our power house floors. This quality of concrete-steel renders it particularly valuable for factories and bridges.

## FIREPROOF.

Numerous tests have been conducted on floors constructed of cinder concrete, particularly under the direction of the Building Department of New York City.

They have demonstrated that good cinder concrete is perhaps the best fireproofing material known.

The tests on stone concrete have been fewer in number, because cinder concrete being much cheaper and lighter is generally used in fireproofing buildings. Trap rock concrete has successfully passed two severe tests, the first a fire test in a small building erected at Mineola, L. I., by the Ransome Concrete Company for the purpose, and the second an actual service test in the Bayonne factory of the Pacific Coast Borax Co., which was built of trap rock concrete and cold twisted steel, by Mr. Ernest L. Ransome, in 1898.

Plate X gives a view of the test building at Mineola after the fire. Figure 1 is a section through the building showing the construction of the walls and the roof.



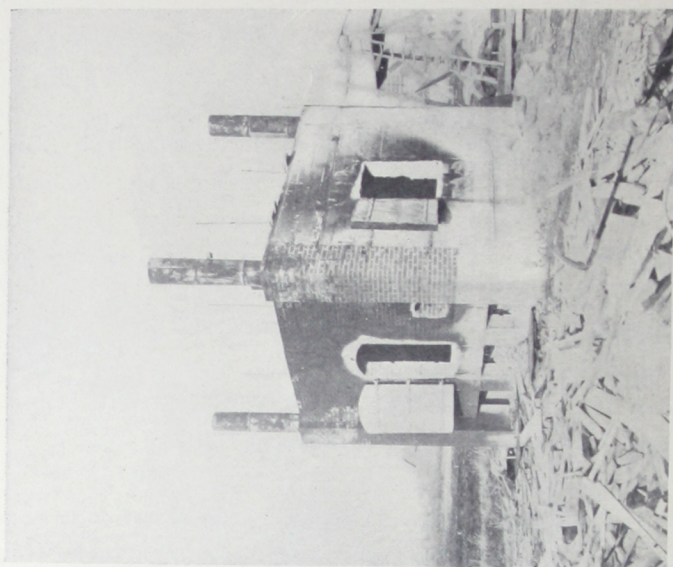


PLATE X. VIEW OF TEST BUILDING AFTER THE FIRE,  
LOAD REMOVED.

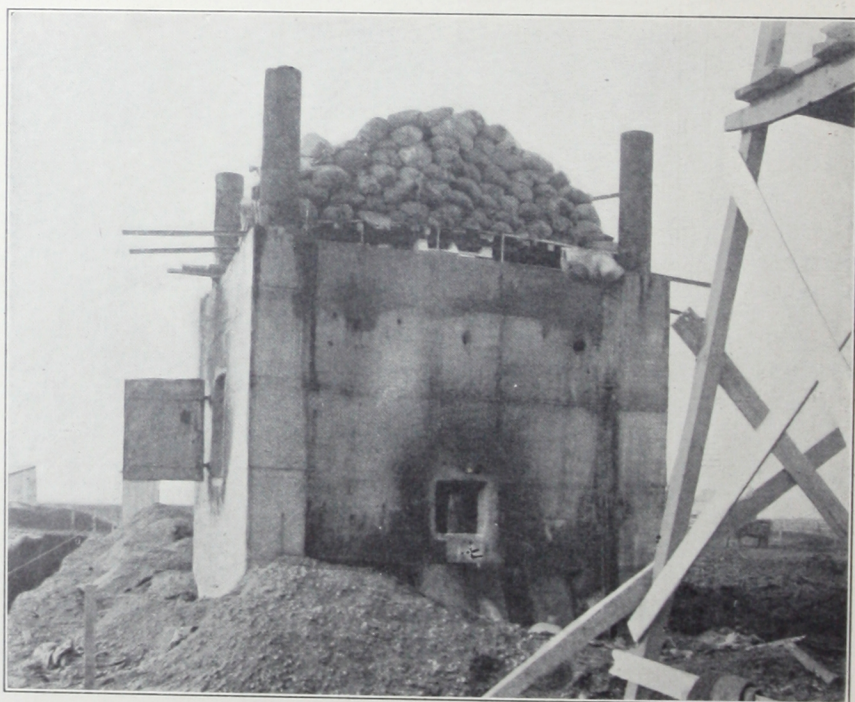


PLATE XI. TEST LOAD AFTER THE FIRE.

Total concentrated load 20,674 lbs., equivalent to distributed load of 1,123 lbs.  
per square foot.

FIRE TEST BUILDING, RANSOME SYSTEM, MINEOLA, L. I.



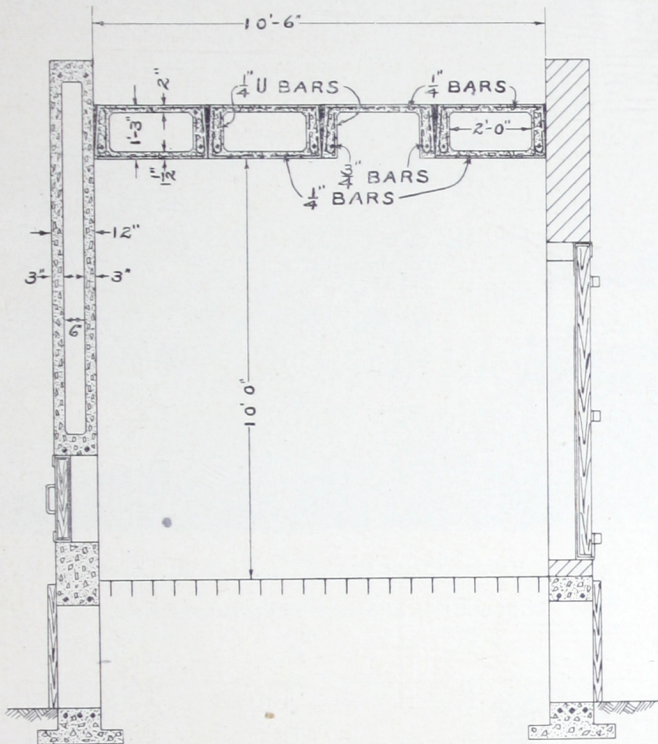


FIGURE 1.

The building was 10'6" wide by 14'0", inside dimensions, with a clear height of 10 feet above the grate bars. Three of the walls were of concrete, consisting of two shells, each 3" thick, separated by a 6" air space, but connected by vertical ribs of concrete 3 feet apart.

The fourth wall was built of brick to afford a comparison between the two materials under the same conditions. The roof was constructed to correspond with the regular Ransome floor construction consisting of concrete beams reinforced with twisted steel bars, a concrete floor slab 2" thick connecting these ribs and concrete ceilings 1½" thick in three of the bays. The rib, roof slab and ceiling were made monolithic, and both the roof and ceiling were strengthened with ¼" twisted steel bars. The concrete was mixed in the proportions of one part of Portland cement to five parts of crushed trap rock, taking the product of the crusher from ¾" down. The building was allowed to stand until the





PLATE XII. PACIFIC COAST BORAX CO. FACTORY, BAYONNE, N. J.  
Built entirely of concrete cold-twisted steel.

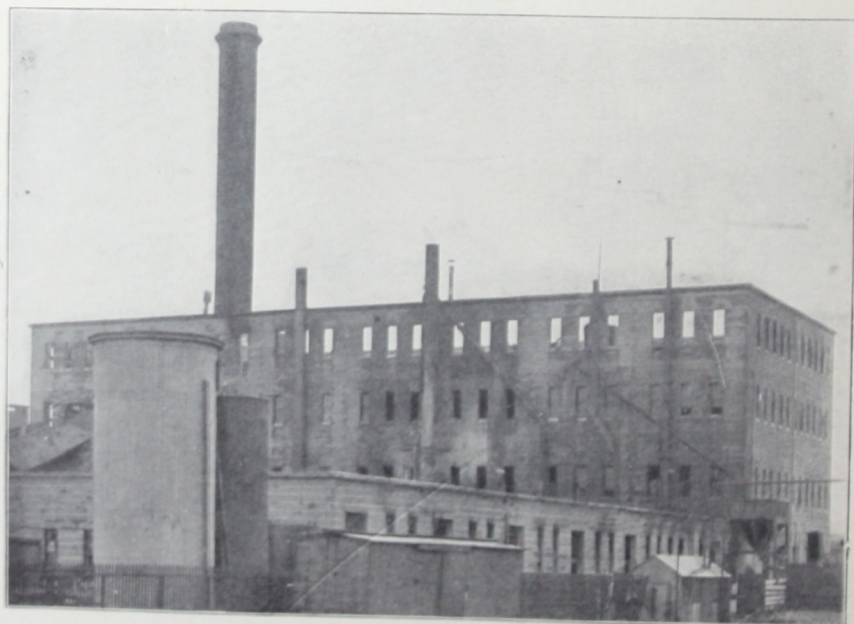


PLATE XIII. REAR VIEW AFTER FIRE.  
Pacific Coast Borax Co. Factory.



following year, when the roof was loaded with bags of gravel to produce an evenly distributed load of 158 lbs. per square foot. This load produced no measureable deflection. The grate bars were covered with about 6" straw, over which was thrown old lumber of all sizes to a depth of three feet. To record the temperature of the fire a pyrometer was rented from Messrs. Eimer & Amend and operated by their expert, Mr. Chaddock. The fire was lighted at 11.40 A.M. on November 29th, 1901, and in ten minutes the temperature reached 842 degrees F. and continued to rise as recorded in the table below.

AVERAGE TEMPERATURE OF FIRE.

| TIME        | TEMPERATURE | TIME       | TEMPERATURE |
|-------------|-------------|------------|-------------|
| 11.50 A.M.  | 842°        | 1.50 P. M. | 1886°       |
| 12 00       | 1472°       | 2.01       | 1746°       |
| 12.10 P. M. | 1405°       | 2.09       | 1832°       |
| 12.20       | 1499°       | 2.20       | 1967°       |
| 12.30       | 1535°       | 2.28       | 1706°       |
| 12.40       | 1580°       | 2.40       | 1868°       |
| 12.50       | 1697°       | 2.50       | 1634°       |
| 1.00        | 1715°       | 3.01       | 1850°       |
| 1.10        | 1526°       | 3.10       | 1697°       |
| 1.20        | 1778°       | 3.20       | 1949°       |
| 1.30        | 1904°       | 3.31       | 1814°       |
| 1.40        | 1571°       | 3.38       | 1922°       |

Additional lumber was thrown on the fire about every twenty minutes to maintain an average temperature of not less than 1,700 degrees, which is the usual practice in such tests. At 3.40 P.M., the fire having burned the specified four hours, the large door in the concrete wall was opened and a stream of water from a 1 $\frac{1}{8}$ " nozzle, under a pressure ranging from 60 to 65 lbs. per square inch, was directed against the concrete walls and ceiling for five minutes. The water was pumped by a steam fire engine from two large watering carts.

As the fire progressed some fine cracks appeared in the concrete walls and one large crack in the brick wall extending from the door to the roof. This crack may have been partially due to the opening of the



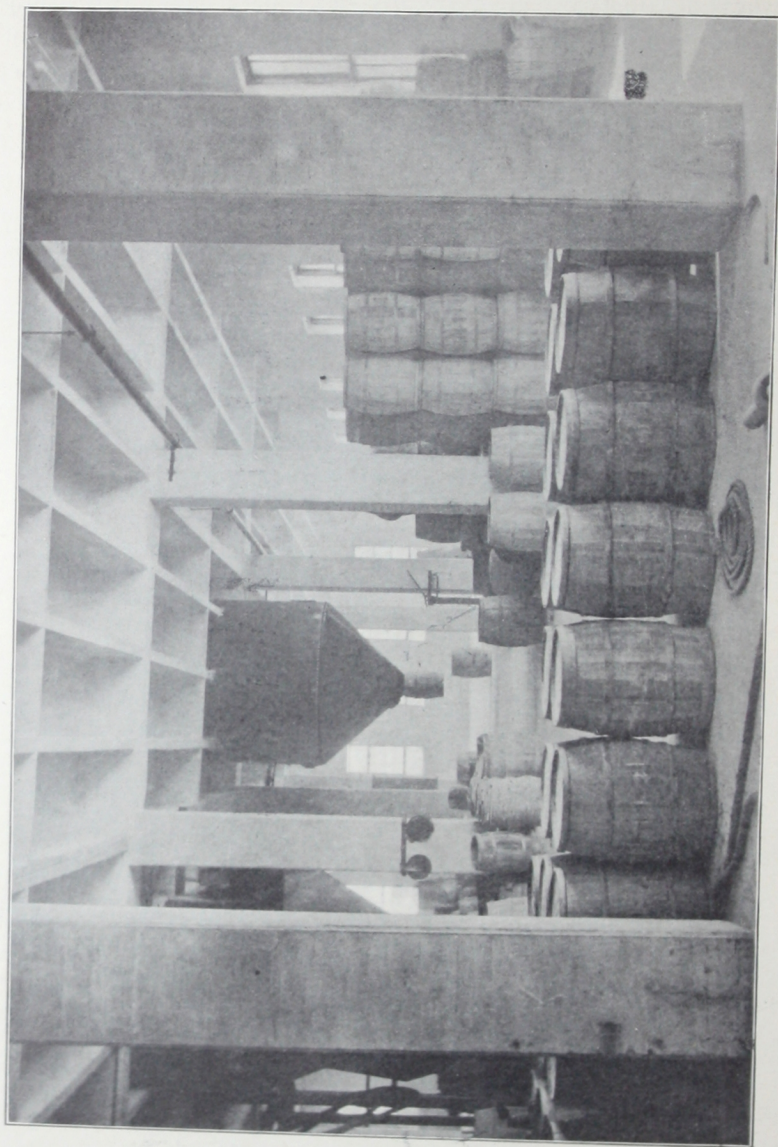


PLATE XIV. INTERIOR VIEW OF PACIFIC COAST BORAX CO. FACTORY, BAYONNE, N. J.



firing door. It finally opened up nearly two inches and bulged away from the roof about four inches. This crack may be seen in the Plate X. Two other serious cracks occurred in the brick wall extending from the small doors across the corners of the building and producing the only large crack which occurred in the concrete walls. The three concrete walls remained absolutely true to line, and at no time were they so warm but that the hand could be held comfortably against them. This is also true of the roof sections having a ceiling which proves conclusively the insulating qualities of the Ransome double wall and floor construction. The roof deflections were read by a level supported on an adjacent platform. The maximum deflections at the center of the beams varied from  $1\frac{1.5}{10}$ " to  $1\frac{2}{10}$ ". The force of the water where concentrated on the concrete ceiling,  $1\frac{1}{2}$ " thick, was sufficient to penetrate it and three holes were thus made in the ceiling. The water also slightly washed the concrete off in other places, exposing some of the small bars in the ceiling, but no vital damage was done as the ceiling could be readily repaired and the strength of the roof construction was unimpaired as proven by the subsequent test load. The inner shell of the concrete walls contained some small vertical cracks and was pitted in spots by the force of the water. The brick wall contained hair cracks running in all directions, in addition to the large cracks previously mentioned.

From the standpoint of repairs the brick wall would have to be taken down and rebuilt, whereas, the strength of the three concrete walls was in no case seriously impaired. The roof had not been penetrated by either the fire or water and had sustained its safe working load without excessive deflection. The maximum deflection after the test was  $1\frac{2}{10}$ " for the section with the ceiling, and 2" for the section without the protection afforded by the ceiling. The load was removed, and an examination made some days later indicated a permanent set of only about  $\frac{1}{4}$ ". To determine the loss of strength, if any, in the roof construction due to the combined action of the fire and water, a concentrated load was gradually applied at the center until equivalent to a distributed load of 1,123 lbs. per square foot without producing any serious deflection.

Plate XI gives a view of the test load. The load remained on the roof during the winter without producing any further injury.

Plate XII is a general view of the factory of the Pacific Coast Borax





PLATE XV. FOURTH FLOOR, SHOWING STEEL TANK WHICH FELL FROM ROOF.

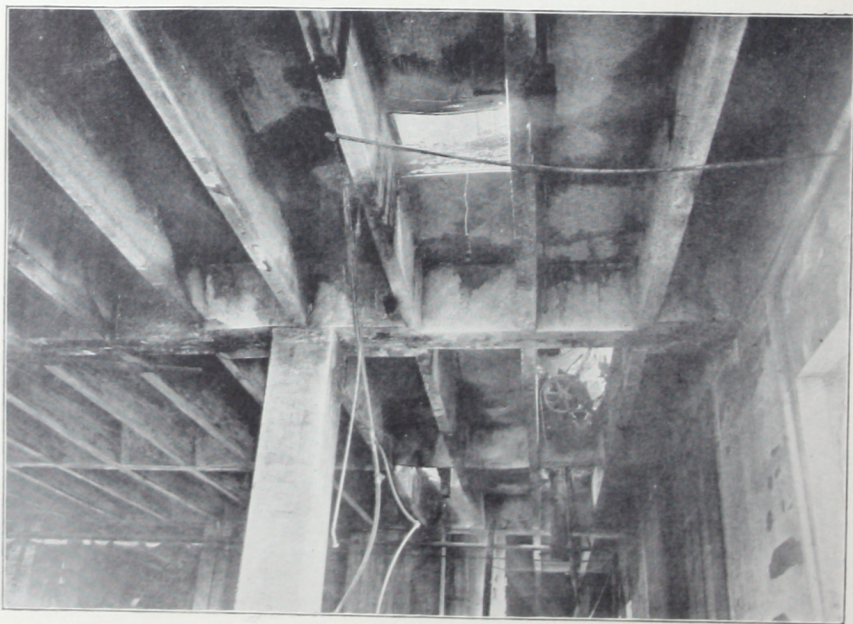


PLATE XVI. UNDERSIDE OF FOURTH FLOOR, SHOWING DAMAGE DUE TO HEAVY TANKS AND MACHINERY FALLING FROM ROOF.

PACIFIC COAST BORAX CO. FACTORY, AFTER FIRE.



Co. before the fire. The building occupies an area of about 200' by 250'. The main building is four stories and the rear portion one story.

The foundations, walls, floors and columns were built of concrete cold twisted steel, but the roof and posts supporting it were constructed of wood. The building contained a large quantity of wooden partitions and framing for shafts, machinery, bins, stairways, etc.

The fire originated in the one-story part on the night of April 6th, 1902, and burned through the wooden roof and partitions separating it from the four-story portion, and then swept up through the elevator shaft and stair wells to the fourth story.

The large quantity of woodwork and other combustible material developed an intense heat, as evidenced by the fusing of copper fittings on the electric motors and cast-iron pieces of machinery. The roof was completely destroyed.

A steel dust collector, weighing about 30 tons, supported on the roof, fell fourteen feet to the fourth floor below, without serious injury to the floor. A few of the floor beams subjected to the shock were slightly cracked but were otherwise uninjured. Several other large tanks supported on the roof also fell to the fourth floor, but in only one case was the thickness of the floor penetrated and that was caused by the blow from the corner of a large tank partly filled. This tank is shown in Plate XV, and the under side of the floor directly below the tank is shown in Plate XVI.

There was also a tank weighing 83 tons when full, standing on the fourth floor, which remained intact during the fire, except the breaking of the discharge pipe permitted the tank to empty. With the exception of the cracking of a few beams on the fourth floor, the punching of one hole in the floor slab, some scaling off of the plaster and whitewash, the entire concrete portion of the building was structurally uninjured by the fire. In contrast with this should be noted the structural steel framing in a shed supporting some tanks in the rear of the main building. The steel columns buckled, bringing down the entire structure, as shown in Plate XVII. A general view of the rear of the building after the fire is shown in Plate XIII.

The owners were able to send out the following letter to their customers:





PLATE XVII. STRUCTURAL STEEL SHED AFTER THE FIRE.



PLATE XVIII.

A good example of the effects of fire on a modern steel frame and hollow tile building.



Gentlemen:

NEW YORK, April 9th, 1902.

Doubtless you have heard that we had a fire at our Factory last Monday evening. It was occasioned by the oil pipe which supplies our roaster with fuel oil, bursting, the oil flooding the lower floor of the building and taking fire, causing a fiercely hot conflagration. On account of the heat and water a great deal of our machinery was badly damaged, but owing to the fact that our Factory is of the Ransome System of Concrete Construction the building itself suffered no injury, and, thanks to this proofness against fire, we will only be delayed a few days in filling orders just received from our customers, whom we sincerely trust will not be inconvenienced by this slight delay.

Yours very truly,

PACIFIC COAST BORAX CO.

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We extract the following from an editorial of the *Engineering News* of October 23rd, 1902, regarding the merits of concrete-steel columns:

"Actual fires have demonstrated that columns will buckle and fail under the action of fire much sooner even than wooden posts. For proof of this statement we may refer the reader to our issue of July 2nd, 1896, in which the destruction of the Washburn & Moen Wire Factory at Worcester, Mass., was described and illustrated. This building had no wood of any consequence in its construction except in the floors and roof, but it went down like a house of cards within a few minutes after the outbreak of a fire from an oil bath used for tempering springs."

"We cite this \$150,000 fire only as a typical example. Numerous similar fires have thoroughly proved that unprotected steel columns are highly vulnerable to flame, and that modern steel frame shop and factory buildings, which were at one time supposed to be practically safe from fire, because built of incombustible materials, are little, if any less, liable to destruction by fire than the wooden frame buildings of a previous generation."



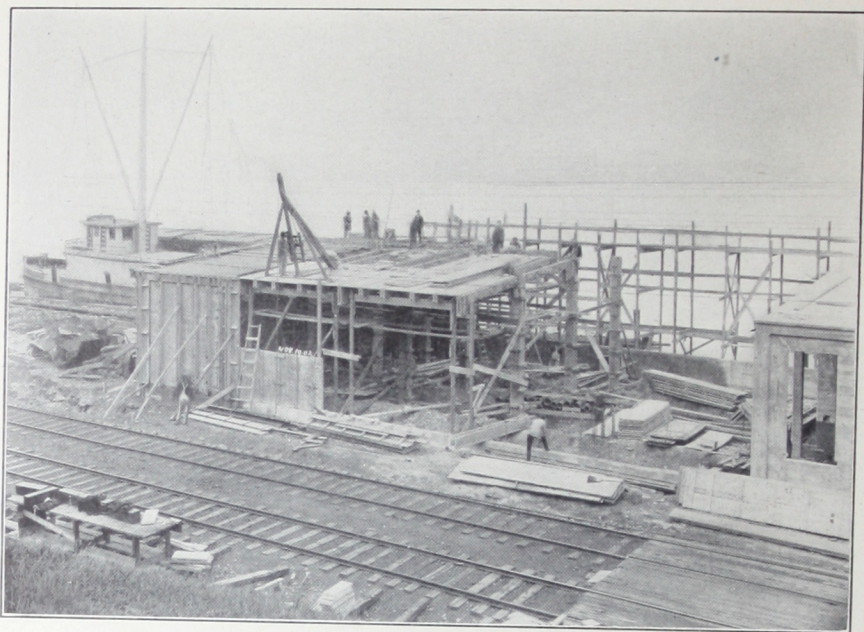


PLATE XVIII. COOPER SHOP DURING CONSTRUCTION.



PLATE XIX. COOPER SHOP.  
PLASTER MILLS, J. B. KING & CO., NEW BRIGHTON, STATEN ISLAND.  
Entirely of Concrete Cold Twisted Steel.



"A concrete-filled column, on the other hand, would be, there is every reason to believe, as stable against fire as any construction known. This would be particularly the case if concrete were made not only to fill but to envelope the whole column. In default of actual experience with such columns in fires, we may refer to the very numerous fire and load tests of floor constructions of concrete and concrete-steel. In view of the record which such materials have shown in fire tests when subjected to heavy bending stresses, one can feel assured of their satisfactory behavior when acting as a column."

"Again as Captain Sewell points out near the close of his article while the start will be to fill present steel columns with concrete, the development will almost certainly be toward the use of columns in which the concrete and not the steel will contribute the chief strength. It is of no small importance to the designer to have a substitute available to which he can turn when the exaction of trusts or the restrictions of labor organizations may make steel high priced or difficult to procure. Cheap concrete is one of the certainties of the future. Dollar cement is among the probabilities. Is it not then important that the engineer has at hand a system by which he may reduce the quantity of steel necessary for his work without at the same time sacrificing the strength and safety of his structure?"

## STEEL REINFORCEMENT.

There have been several different steel shapes used for strengthening the concrete, but none of them so simple or effective in producing an absolute tie between the steel and concrete as a square bar, cold twisted. Plain round or square bars have been used, but it is now generally admitted by concrete engineers that some form of mechanical bond is essential to secure reliable and permanent results. To grasp the real hold of the concrete on the twisted bar it is only necessary to call to mind the holding power of a screw in wood.

Square bars of steel, twisted cold, possess two other points of superi-



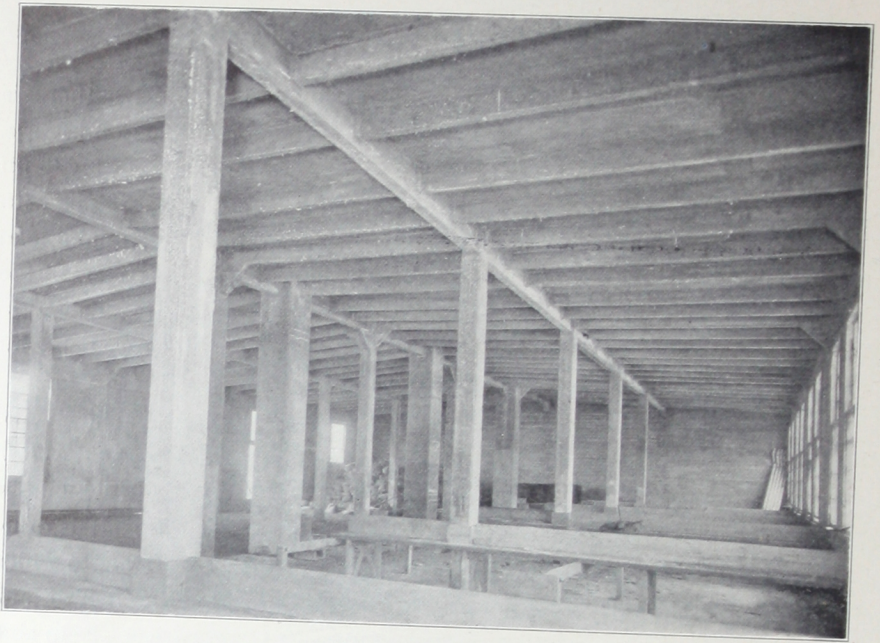


PLATE XXI. INTERIOR VIEW OF COOPER SHOP.

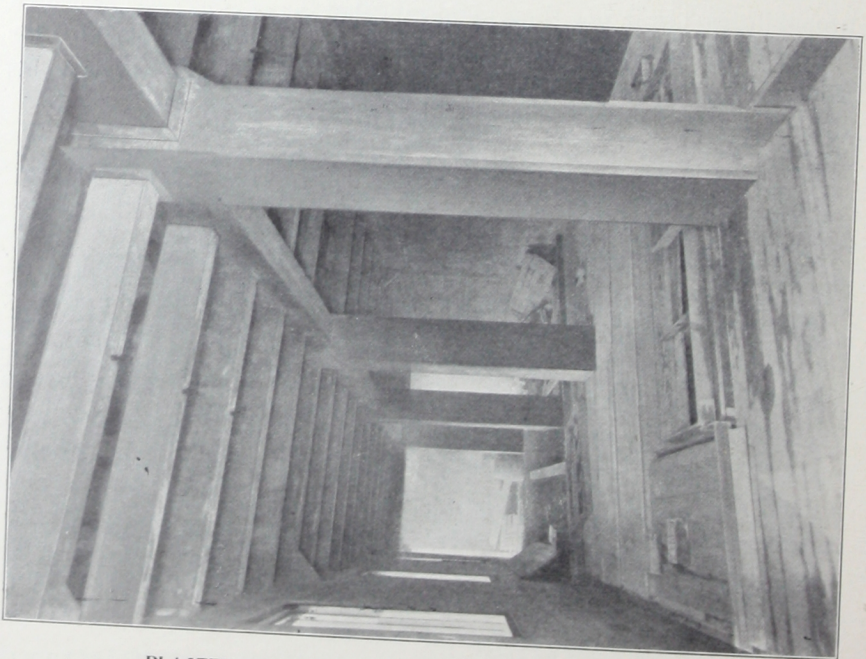


PLATE XXII. INTERIOR VIEW OF LIME MILL.

PLASTER MILLS, J. B. KING & CO., NEW BRIGHTON, S I.  
Entirely of Concrete Cold Twisted Steel.



ority over all other forms, namely: greater strength per pound of steel and a lower ductility permitting a closer unison of action between the steel and concrete. The following table gives the comparative strength in pounds per square inch of mild steel bars and cold twisted steel bars made from the same lot of steel. The tests were made at the testing laboratory of Columbia University, by Prof. Ira H. Woolson. The results given are the average of four or more tests.

| SIZE AND CONDITION        | ELASTIC LIMIT | ULTIMATE STRENGTH |
|---------------------------|---------------|-------------------|
| $\frac{1}{4}$ inch, plain | 46170         | 57800             |
| $\frac{1}{4}$ " twisted   | 62350         | 86700             |
| $\frac{3}{4}$ " plain     | 34840         | 59200             |
| $\frac{3}{4}$ " twisted   | 56720         | 85240             |
| $\frac{7}{8}$ " plain     | 39700         | 62100             |
| $\frac{7}{8}$ " twisted   | 56150         | 84730             |

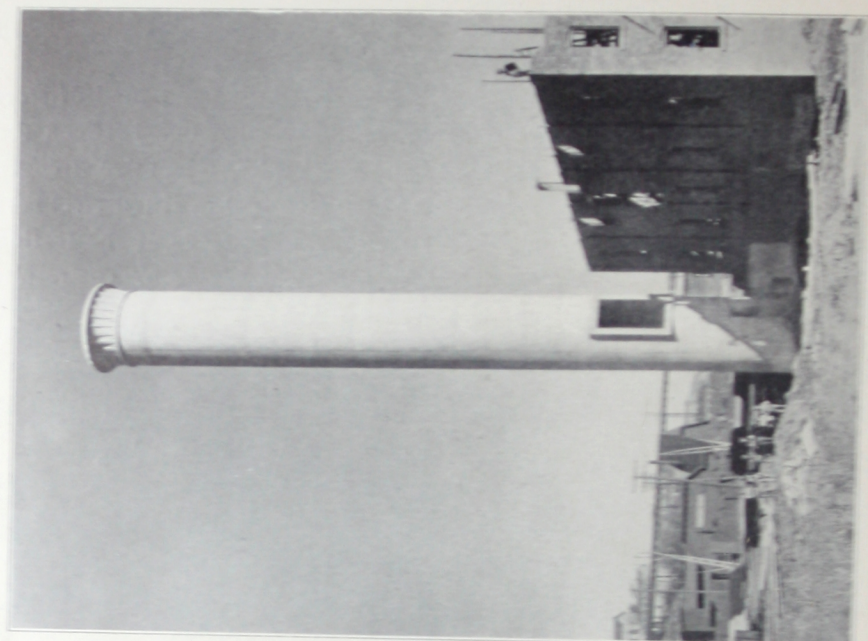
## CORROSION.

The durability of concrete-steel requires that the steel shall be permanently protected from corrosion. Engineers, generally, who have investigated the preservation of steel, or have examined steel that has been embedded for a long time in concrete or cement mortar, are agreed that good Portland cement mortar, or concrete will permanently preserve steel from corrosion.

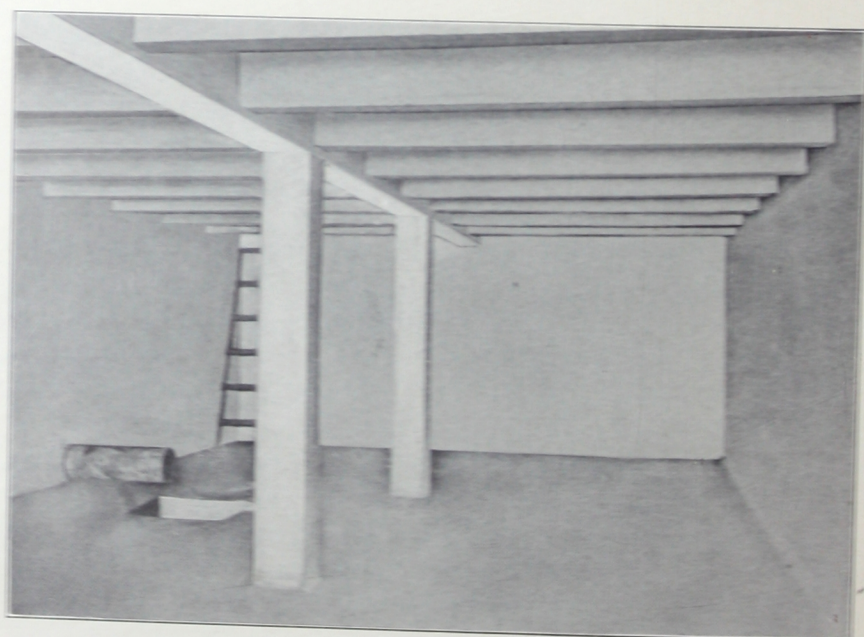
Mr. J. K. Freitag, in his book on "Fireproofing of Steel Buildings," states: "The preservative qualities of cement mortar are now very generally recognized. Innumerable instances are recorded of iron having been embedded in cement-mortar for ages without appreciable change in condition. Iron clamps, laid in cement joints in the Parthenon, have been uncovered and found to be in excellent preservation.

At the time of pulling down the old Herald Building, which had





CONCRETE CHIMNEY, RANSOME SYSTEM.  
CENTRAL LARD CO., JERSEY CITY, N. J.  
Height 100'. Internal diameter 10'.



INTERIOR OF SMITH & KAUFMANN RESERVOIR, NEW YORK CITY.  
Entirely of concrete cold-twisted steel.



been built for about thirty years, Architect George B. Post directed his inspector to bring him the worst corroded pieces of iron found in the building. No bad examples were found, and where the mortar had been in absolute contact with the paint, the paint itself was preserved."

We also quote from an editorial in the *Engineering News* of July 1st, 1897: "We believe it is a fact, about as well established as anything in the engineering science, that iron or steel which is encased in mortar of either lime or cement will be permanently preserved from corrosion. But engineering knowledge on this subject is not confined to theory. Engineers know from thousands of recorded instances that iron or steel embedded in mortar is preserved for many years without loss of section. And, knowing this, it appears to us like infinitesimal hairsplitting to question the durability of a combined concrete and metal floor on the ground that the metal embedded in the solid concrete may rust out in the course of time."

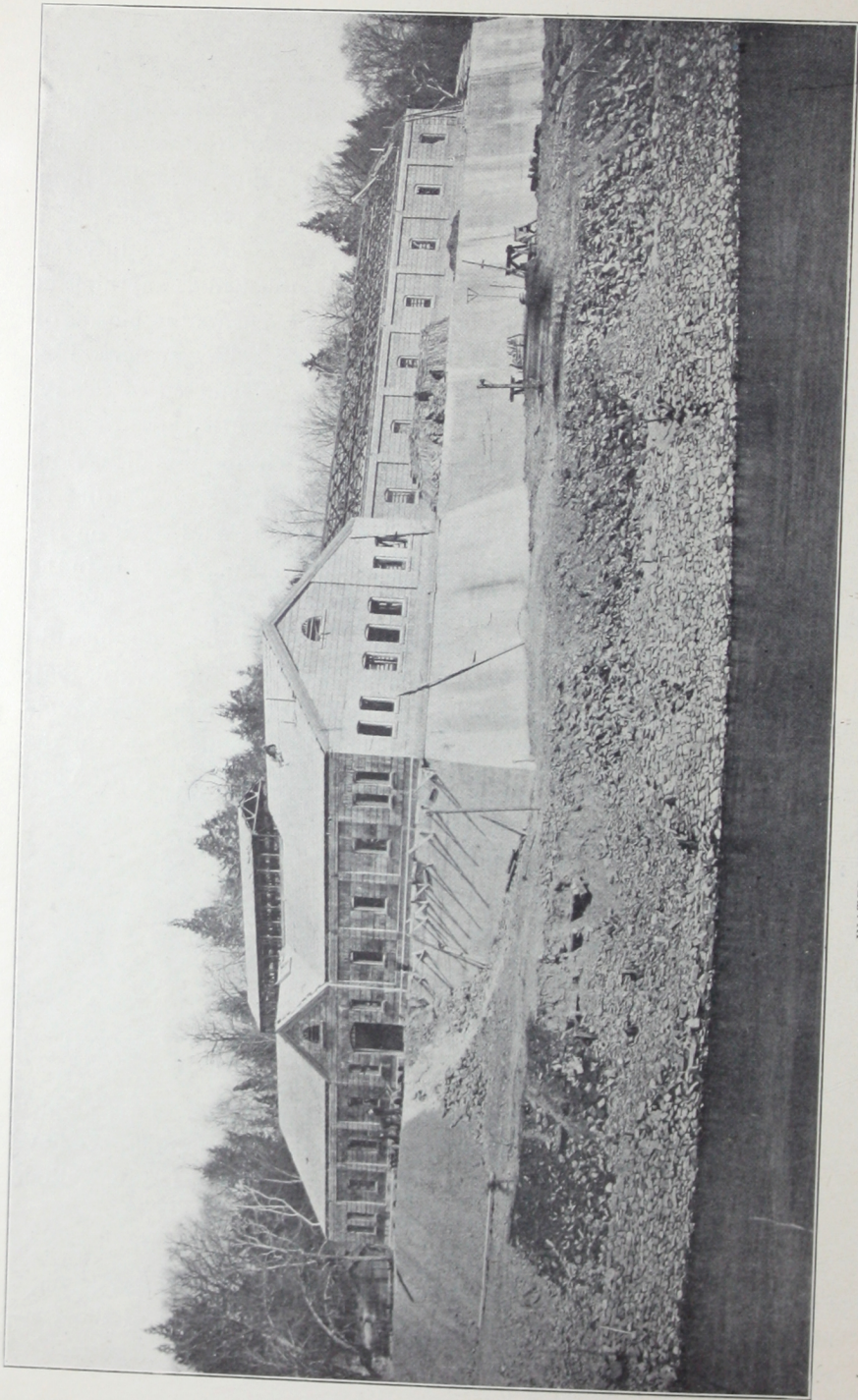
For the benefit of those who may wish to look further into this subject, we refer to an article in the *Engineering Record* of August 3rd, 1901, by Mr. William Copeland Furber, M. Am. Soc. C. E.; in the *Engineering News* of April 24th, 1902, by Prof. Spencer B. Newbury, and in the *Engineering News* of October 23rd, 1902, by Prof. Charles L. Norton and Capt. John S. Sewell, Corps of Engineers, U. S. A.

## IMPERMEABILITY.

Concrete may be made impervious to water and is, therefore, adapted to the construction of reservoirs, water conduits, sewers, etc. We have recently completed two reservoirs of 70,000 gallons and 100,000 gallons respectively. One of them is illustrated on page 30.

The water purification plant of the East Jersey Water Co., at Little Falls, N. J., was built entirely of concrete, and the stand pipe, 40' high, filter tanks, floors and operating building were constructed of the Ransome System. A general view of the building is shown on page 32.





WATER PURIFICATION PLANT, RANSOME SYSTEM.  
EAST JERSEY WATER CO., LITTLE FALLS, NEW JERSEY.  
Joseph Sharpe, Paterson, N. J., Contractor.



## RAPIDITY OF ERECTION.

The material for concrete cold-twisted steel construction consists of square steel bars, Portland cement, broken stone or gravel and sand, all of which are carried in stock in quantity or can be obtained on short notice. Contracts for buildings or other work can be executed immediately and in many cases completed before the structural steel could be shipped from the mill.

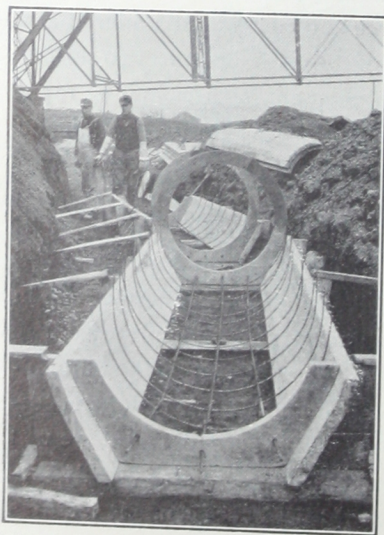
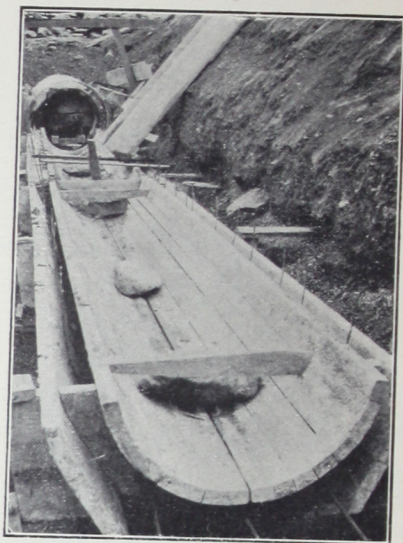
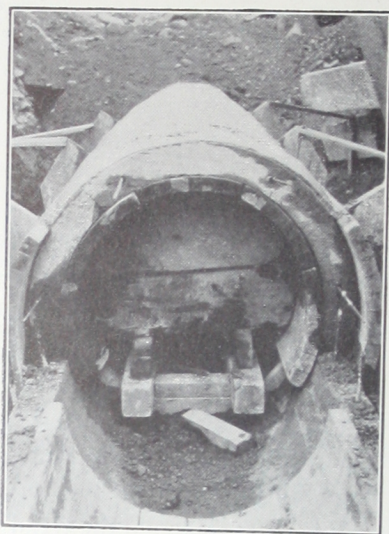
In this catalogue we aim to give the reader some idea of the scope of concrete-steel construction and its adaptability to various building operations. Much has already been done, but if we mistake not the trend of the times, very much greater progress will be made in the immediate future.

First quality timber is becoming scarce and costly and under many conditions is subject to rapid deterioration. Steel is open to two serious objections: its loss of strength under only moderate fires and its rapid corrosion, requiring very large maintenance charges for inspection and painting.

As to the merits of concrete-steel, we quote the opinion of Capt. John S. Sewell, expressed in *Engineering News* of January 29th, 1903, as follows:

"At the present time European practice is far ahead of American in the use of reinforced concrete. Yet the underlying principle of entire success is merely this: the concrete should be reinforced against all tensile stresses, whatever their location and direction. If this is done accurately, steel frames for buildings will no longer be needed, and there will result a type of building stronger, cheaper and more thoroughly fire-proof, and more enduring than any the world has ever seen. It requires but a finishing touch to round out the correct theory; may this much, at least, be accomplished on this side of the Atlantic. And while American architects and engineers have been slow to begin, may it fall to their lot to perfect that application of what seems, at last, an ideal material for buildings and other important structures.





# CONCRETE SEWER, RANSOME SYSTEM.

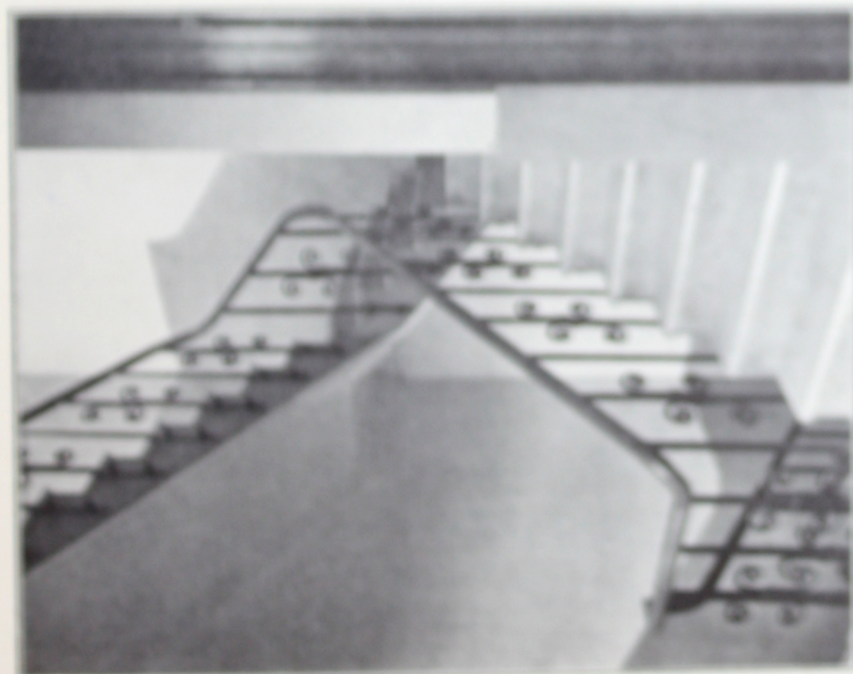
Built by Westinghouse, Church, Kerr & Co., Scranton, Pa.

Designed by Turner Construction Co.





ORDERING OF FLOOR CONSTRUCTION



STAIRCASE, ORDERING OF FLOOR CONSTRUCTION

*John H. Brown, Architect*

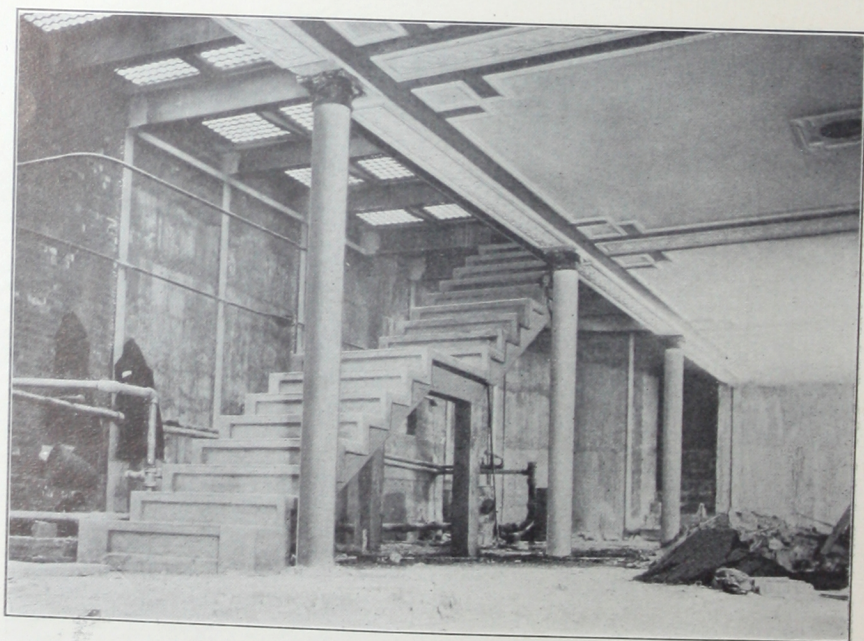
VE. GARDEN, SCHOOL, NEW BRUNSWICK, N. Y.

Floors, roof, partitions and stairways constructed of concrete and twisted steel.





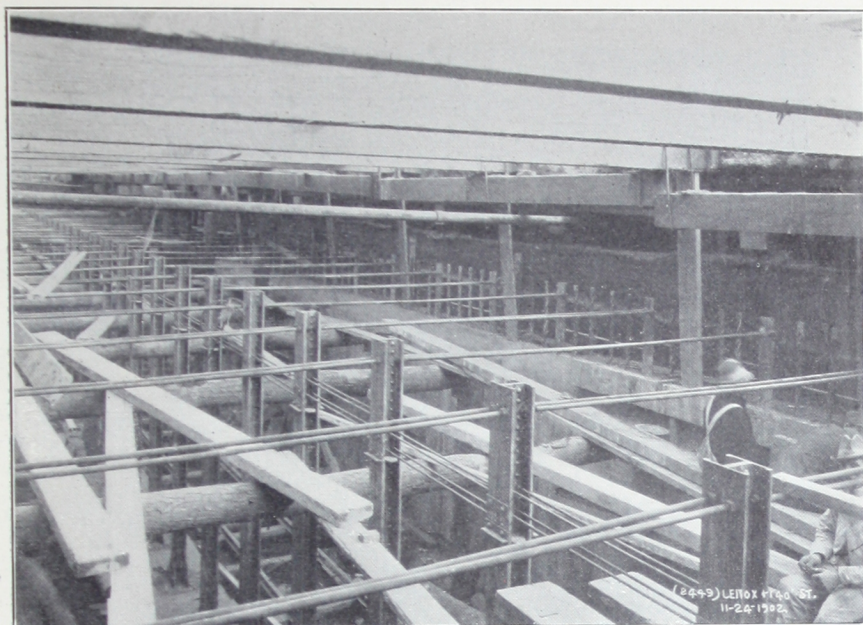
STAIRWAY READY FOR CONCRETE.



COMPLETED STAIRWAY, BLEECKER STREET STATION.  
STAIRWAYS, RAPID TRANSIT SUBWAY STATIONS.

Entirely of concrete cold-twisted steel.





CONCRETE WALLS REINFORCED WITH COLD-TWISTED STEEL BARS.

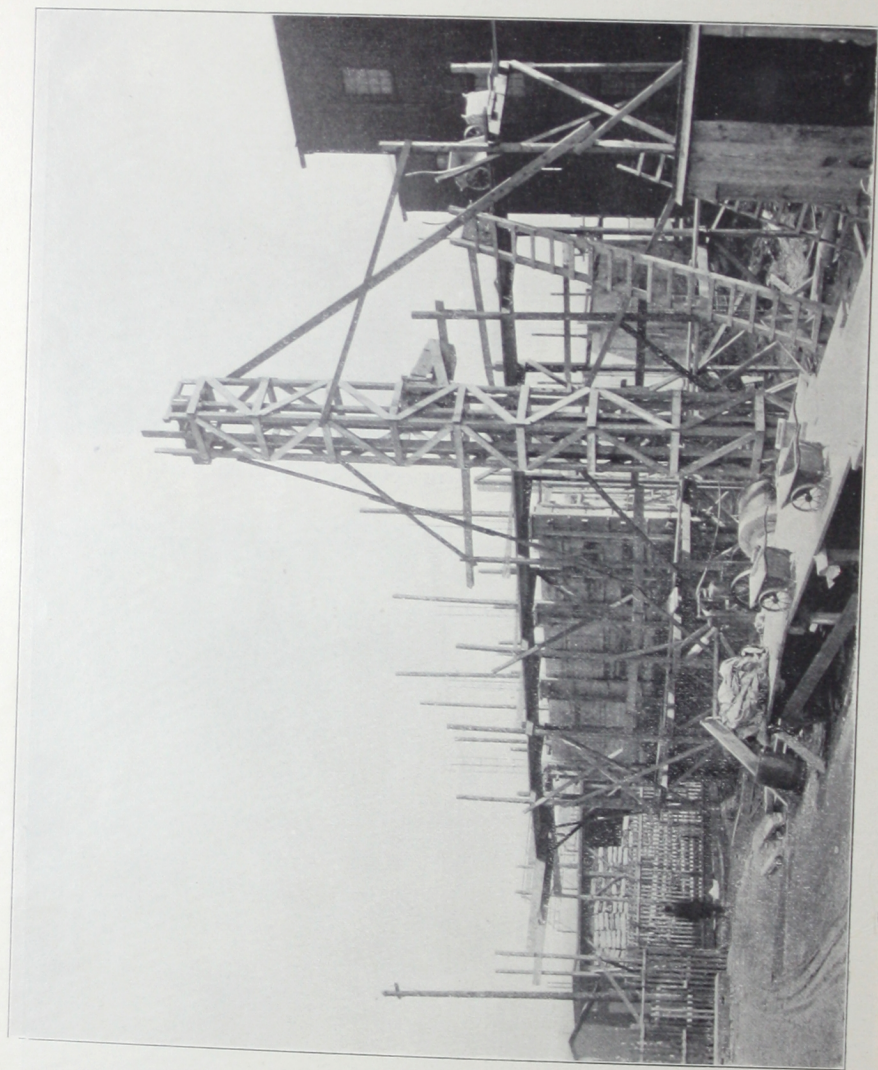


CONCRETE ROOF REINFORCED WITH COLD-TWISTED STEEL BARS.

**LENOX AVENUE EXTENSION, RAPID TRANSIT SUBWAY, NEW YORK.**

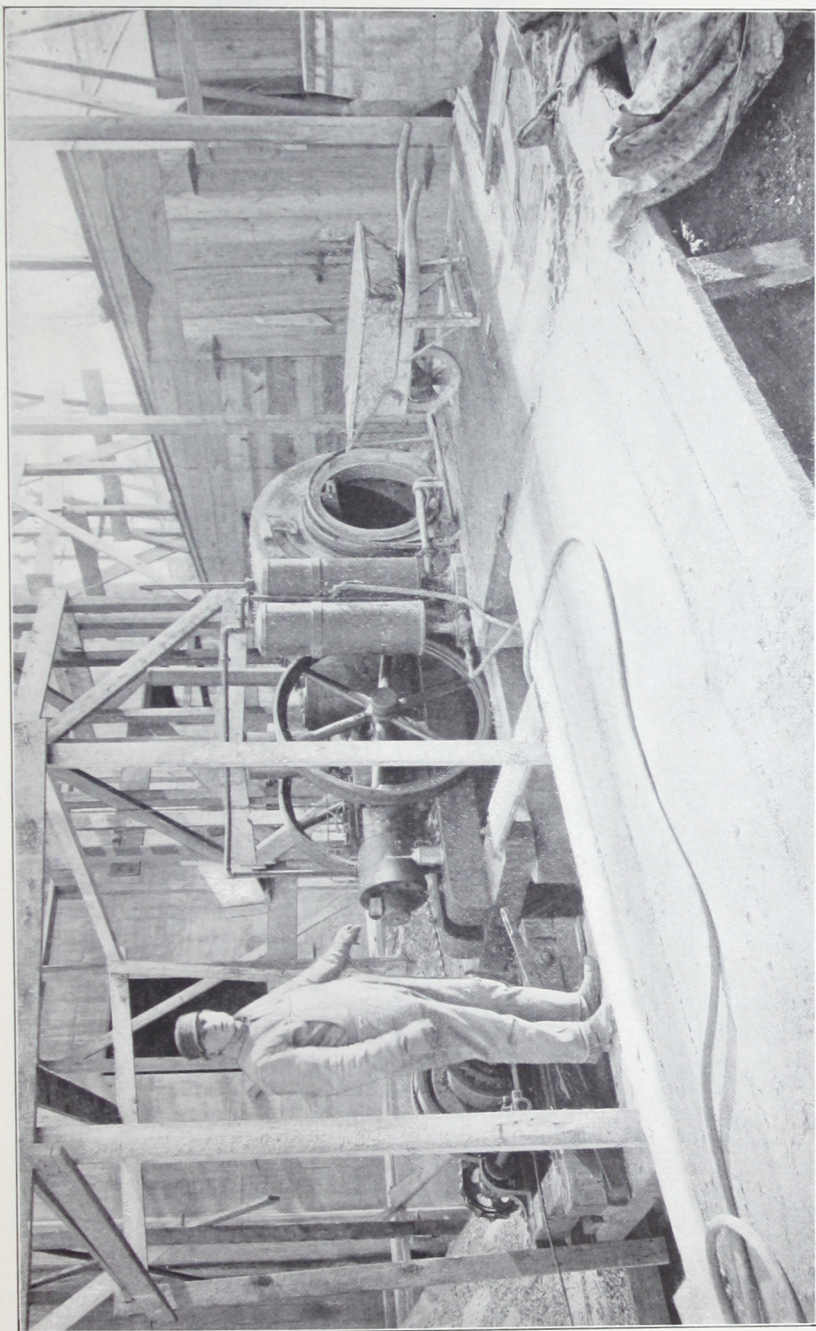
The Brooklyn Subway is also designed for this construction.





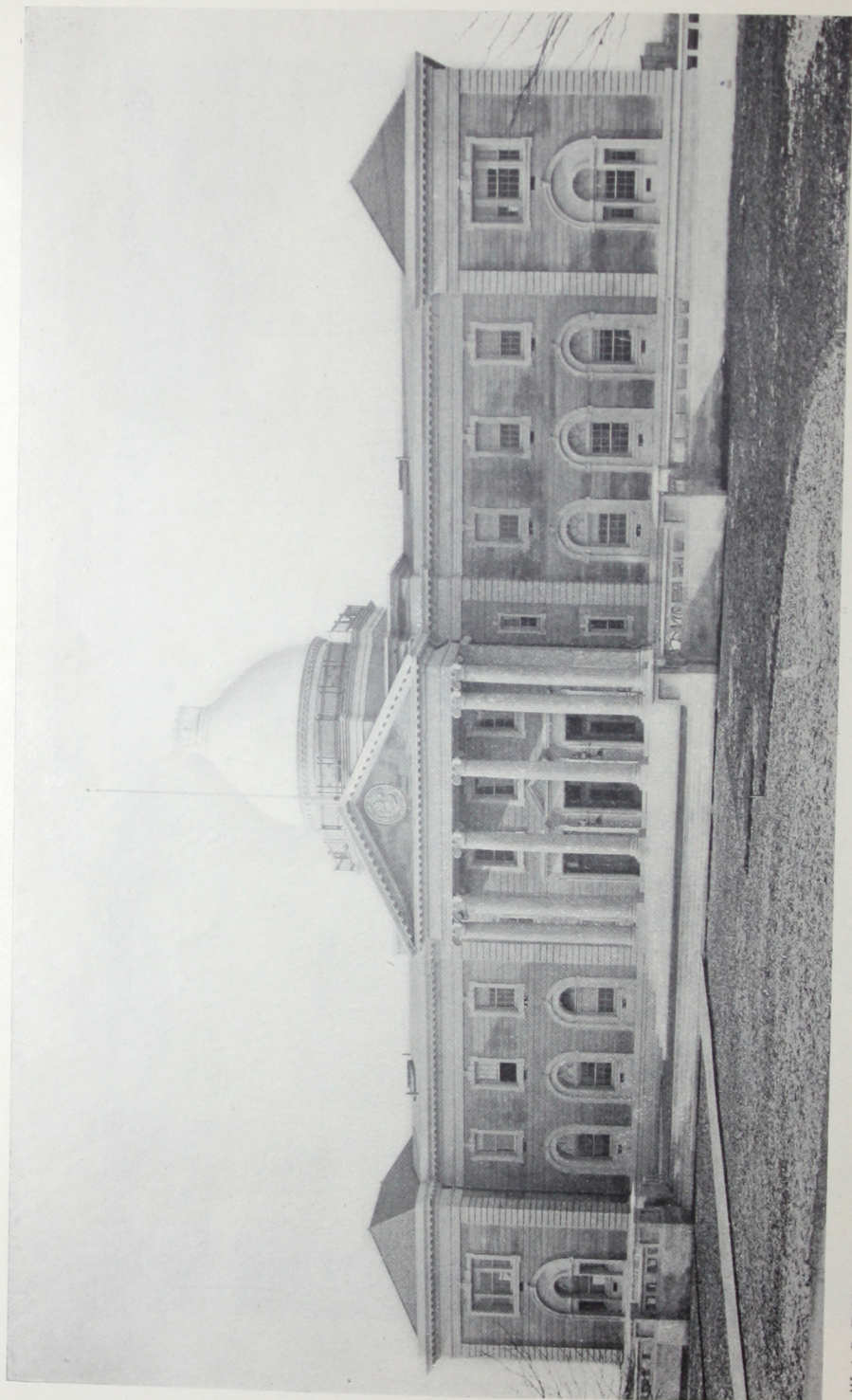
Concrete Wall (Ransome System) during Construction 410' long 50' high.  
**BERGENPORT CHEMICAL WORKS, STANDARD OIL CO., BAYONNE, N. J.**





RANSOTE MIXER. — J. B. KING & CO. WORK.  
All concrete mixed by machinery.



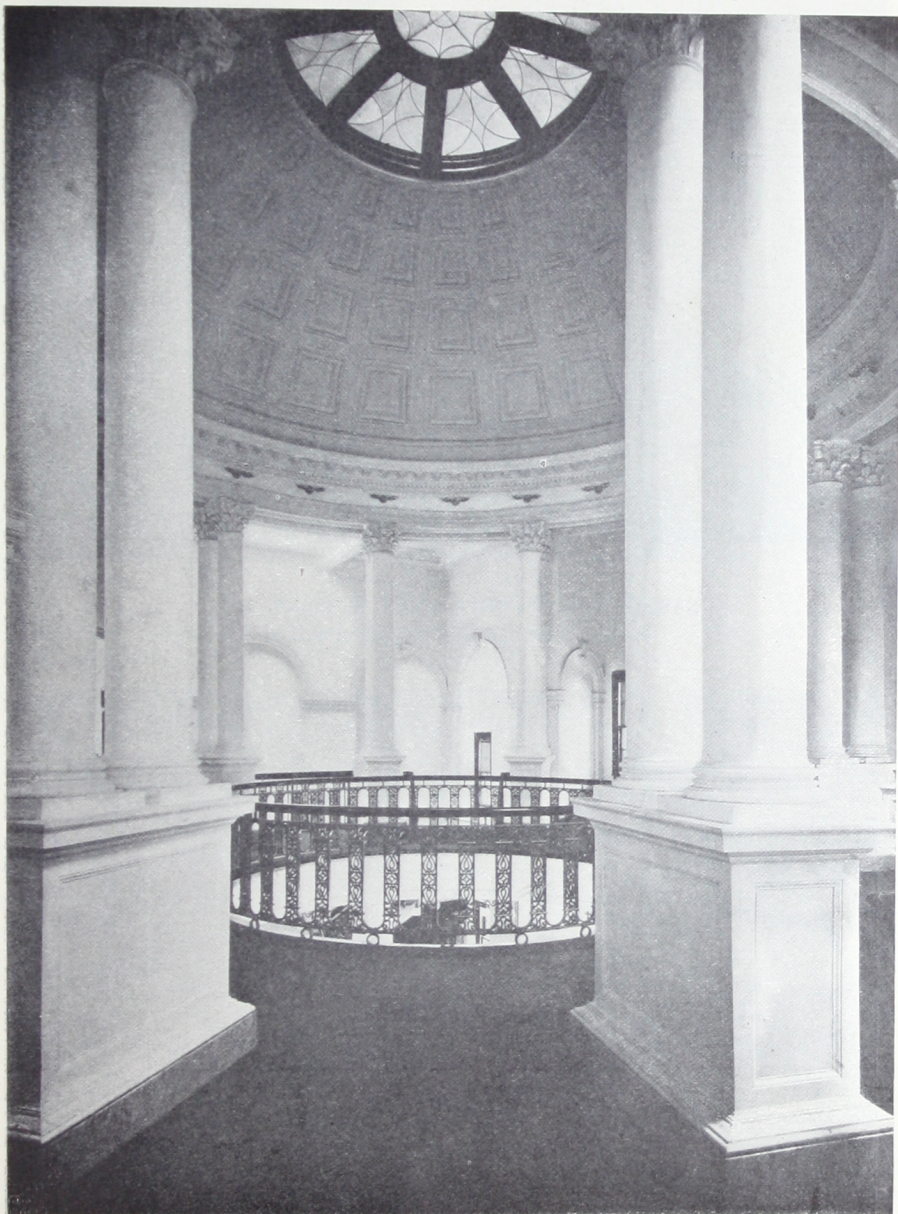


*Wm. B. Tubby & Bro., Architects.*

**NASSAU COUNTY COURT HOUSE, MINEOLA, LONG ISLAND.**

Built entirely of concrete cold-twisted steel, Ransome System. Edward Roche, Contractor.





INTERIOR OF DOME.

NASSAU COUNTY COURT HOUSE, MINEOLA, L. I.

Concrete Ransome System. Plaster finish.





INTERIOR OF COURT ROOM.  
**NASSAU COUNTY COURT HOUSE, MINEOLA, L. I.**  
 Ransome arched beams; plaster finish.



*Wm. B. Tubby & Bro., Architects.*

**NASSAU COUNTY JAIL, MINEOLA, L. I.**  
 Built entirely of concrete cold twisted steel, Ransome system.  
 Edward Roche, Contractor.





**ST. JAMES CHURCH, BROOKLYN, N. Y.**

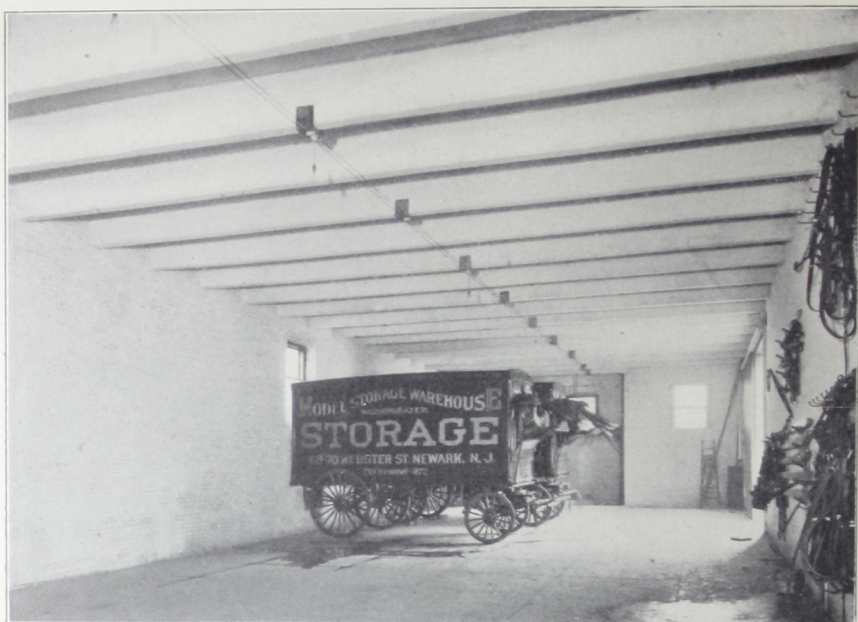
Built of concrete cold twisted steel. Ransome Concrete Co., Contractor.



**ROBERT A. VAN WYCK LABORATORY, N. W. YORK.**

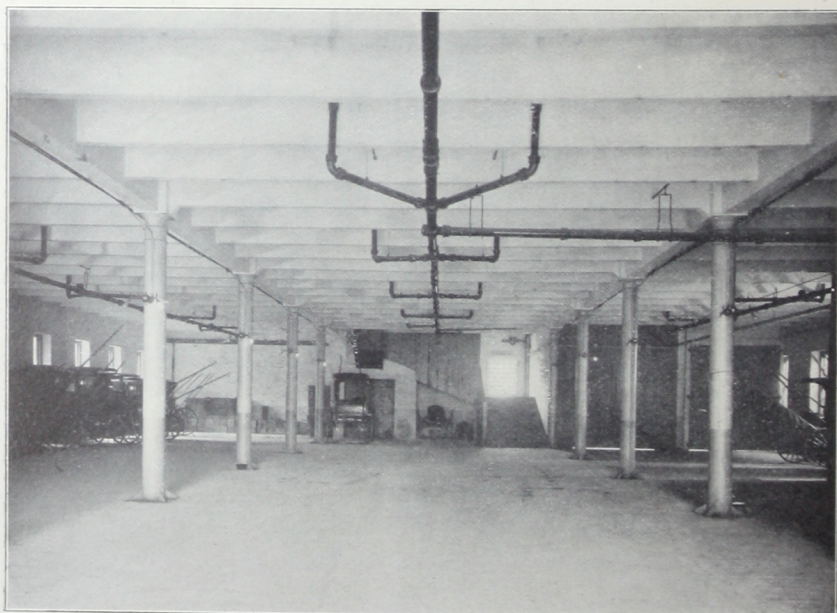
Built of concrete cold twisted steel. Morris Building Co., Contractor.





MODEL STORAGE WAREHOUSE, NEWARK, N. J.

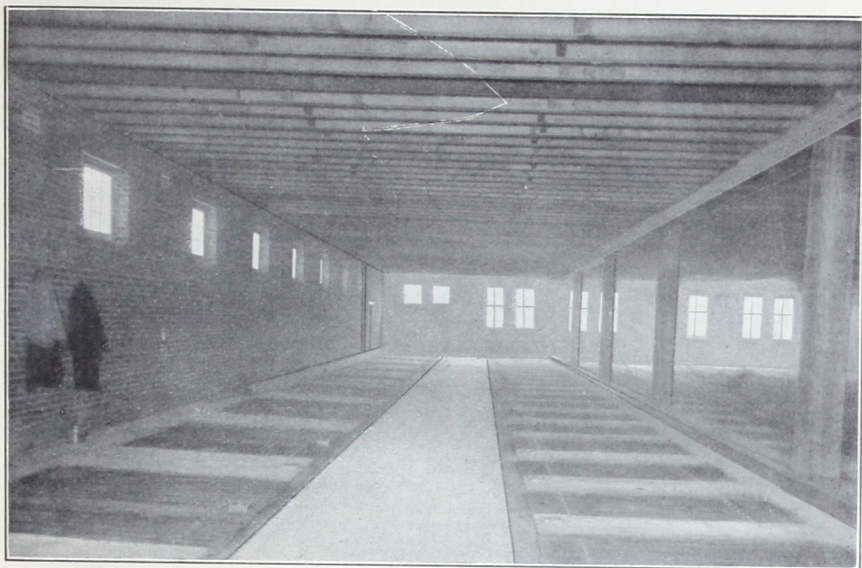
Beams, 31 feet span. Live load, 250 lbs. per square foot. Ransome system.  
Joseph Sharpe, Contractor.



MEADOWBROOK STABLE, NEWARK, N. J.

Beams, 26' span. Girders, 18' 6" span. Ransome system.  
Joseph Sharpe, Contractor.





GRANOLITHIC WATERPROOF STABLE FLOOR. GUTTER FORMED IN CONCRETE.

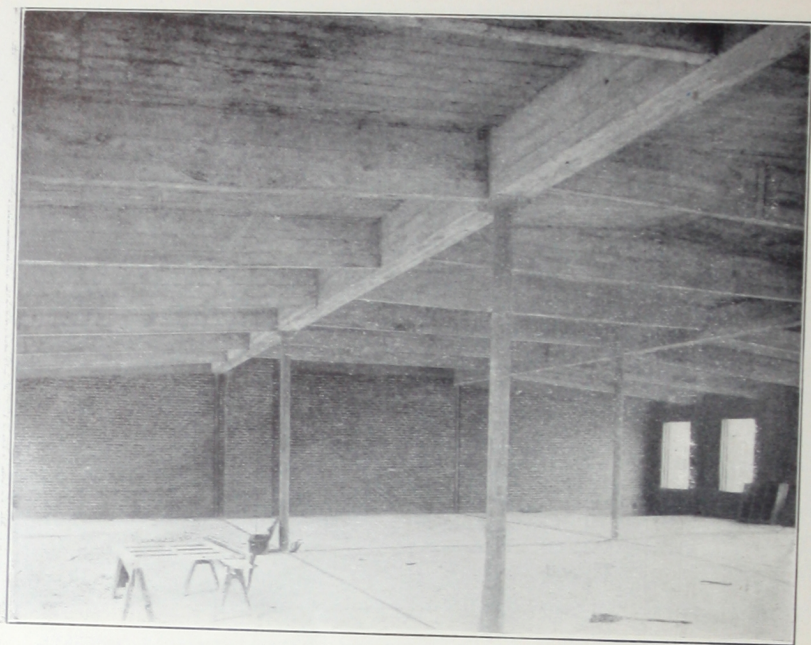


UNDERSIDE STABLE FLOOR SHOWING RANSOME BEAMS AND GIRDERS.

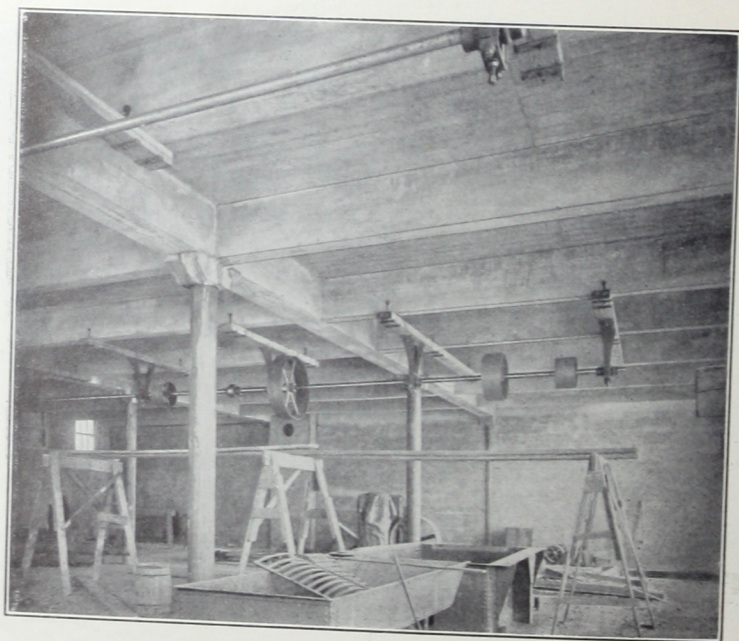
**SANDERSON STABLE, NEWARK, N. J.**

Joseph Sharpe, Contractor.





UNDER SIDE OF ROOF CONSTRUCTION.



UNDER SIDE OF FLOOR CONSTRUCTION.

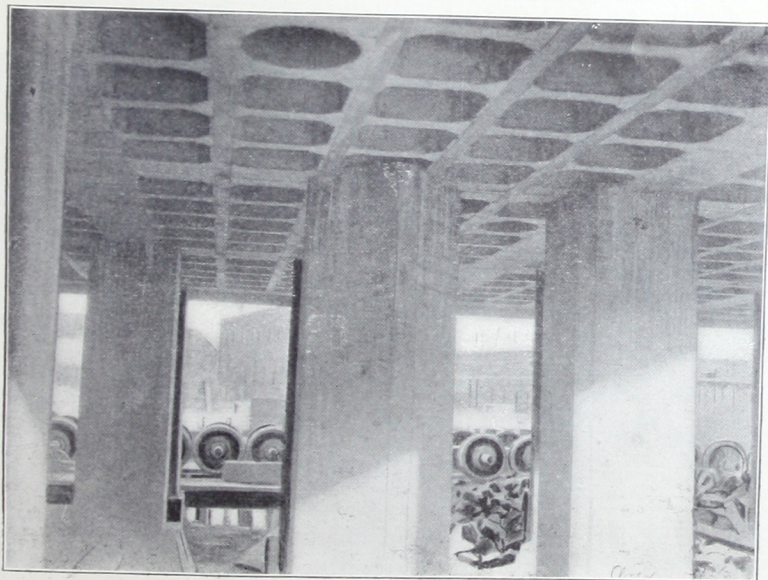
**BOTTLING DEPARTMENT, STEGMAIER BREWING CO., WILKES-BARRE, PA.**

Beams, 23 feet span; girders, 22 feet, 6 inches span; working load, 250 lbs. per square foot, Ransome system. Joseph Sharpe, Builder.





SIDE VIEW.

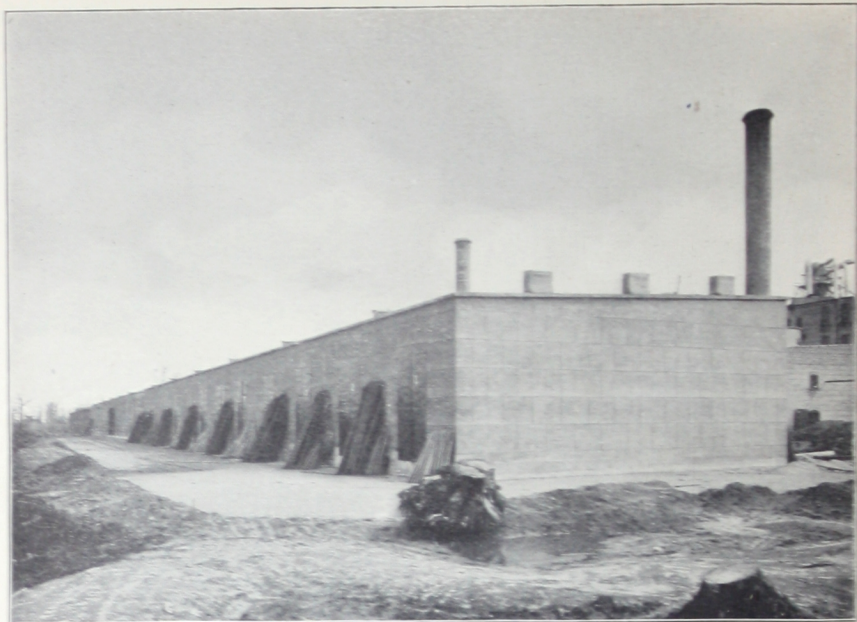


UNDER VIEW.

**EASTERN ELEVATOR FLOOR, BUFFALO, N. Y., RANSOME SYSTEM.**

Span, 12 feet; depth, 3 feet; working load, 4500 lbs. per square foot.  
Donnelly Contracting Co., Buffalo, N. Y., Contractors.





VIEW OF CHIMNEYS AND DRY KILNS, RANSOME SYSTEM.

SINGER MANUFACTURING CO., SOUTH BEND, ILL.

Twenty-four dry kilns, 527 feet, 4 inches x 52 feet. Chimneys, 130 feet high. Internal diameter, 6 feet. A. Mönsted & Co., Milwaukee, Wis., Contractors.



VIEW OF WATER-TIGHT TANKS, RANSOME SYSTEM.

SINGER MANUFACTURING CO., CAIRO, ILL.

Sixty-four water-tight tanks to hold strong lye.  
A. Mönsted & Co., Milwaukee, Wis., Contractors.





**BRIDGE OVER TACONY CREEK, OGONTZ, PA.**

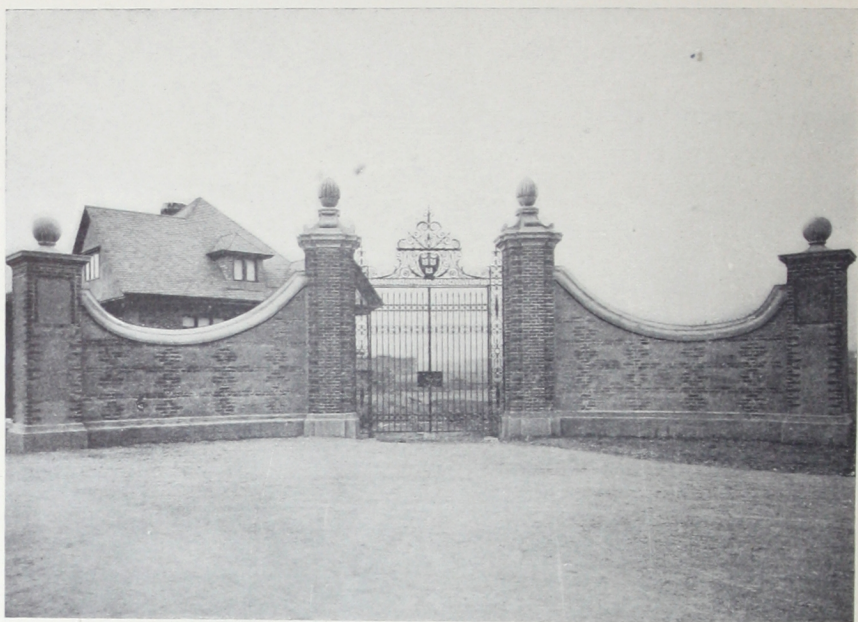
Twenty-five feet span. Ransome system. Ransome Construction Co., Contractor.



**BRIDGE OVER PERKIOMEN CREEK, UPPER SALFORD, PA.**

Thirty-five feet span. Ransome system. Built by Ransome Construction Co., Philadelphia, Pa.





NEWELL GATE.



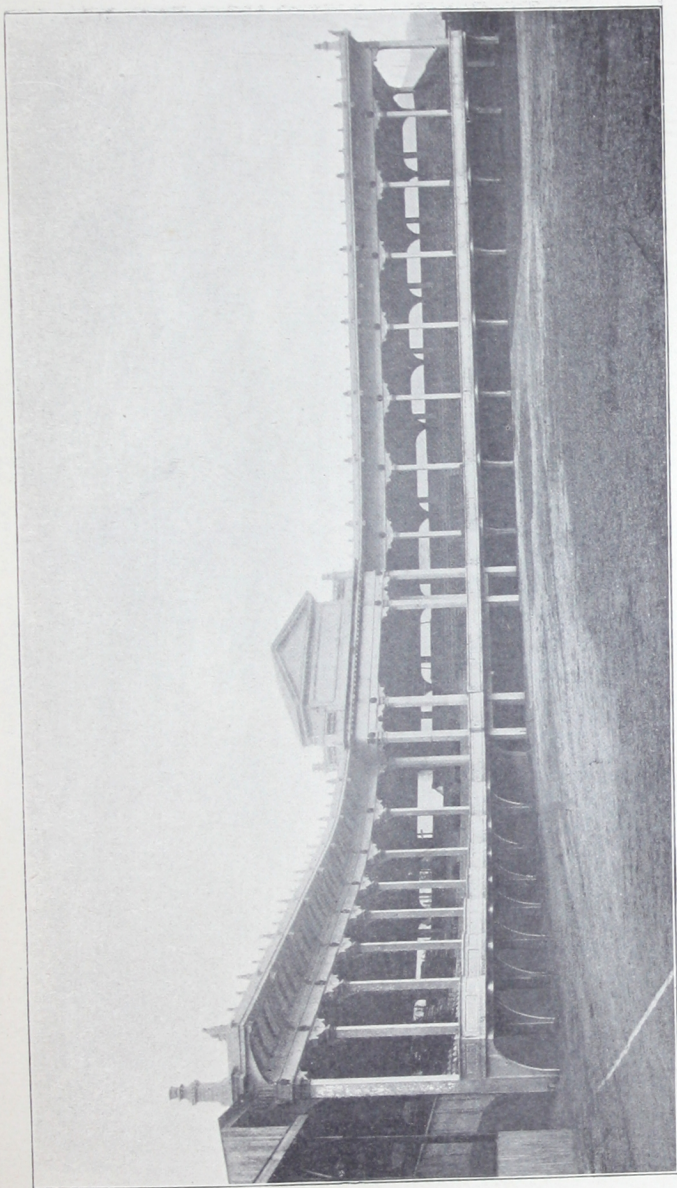
*H. Langford Warren, Architect.*

MAIN GATE.

**NEWELL MEMORIAL AND MAIN GATE RESPECTIVELY, SOLDIERS' FIELD,  
HARVARD UNIVERSITY ATHLETIC FIELD.**

Concrete beams and posts with brick ornamental corners. The caps were cast and set like stone. Aberthaw Construction Co., Contractors.



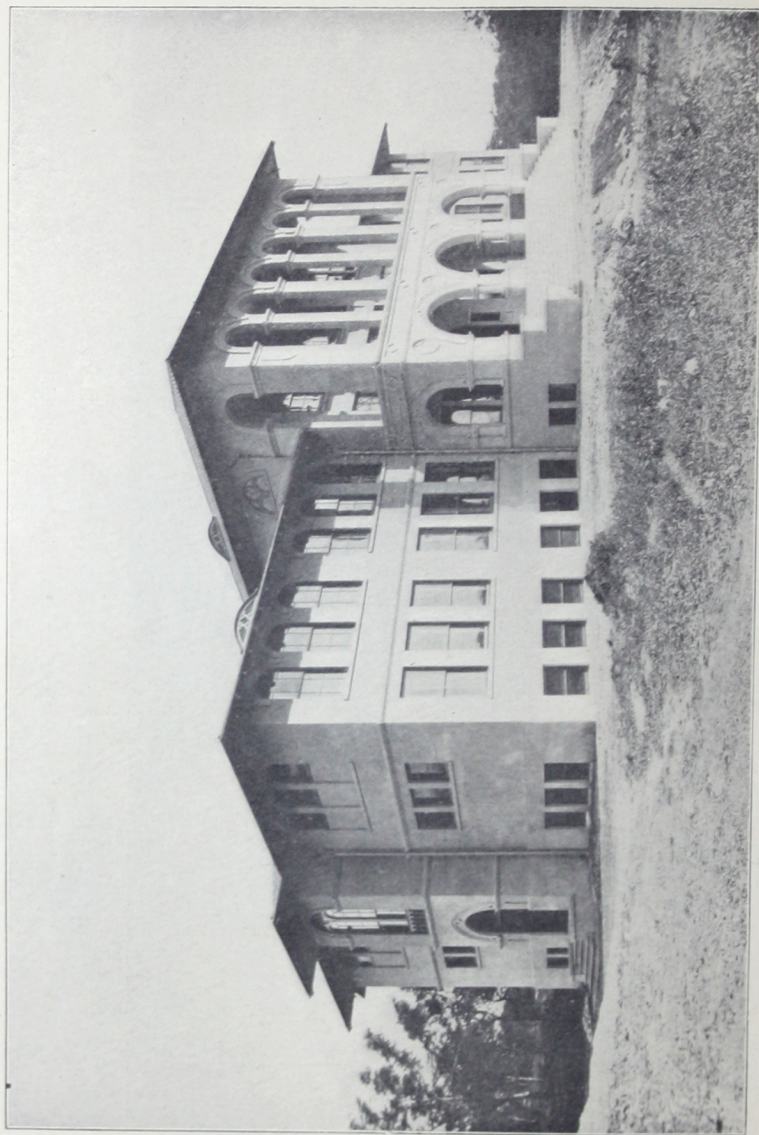


GRAND STAND, BASEBALL GROUNDS, CINCINNATI, OHIO.

Built entirely of concrete cold-twisted steel.

By Ransome Concrete Fireproofing Co., Cincinnati, Ohio.

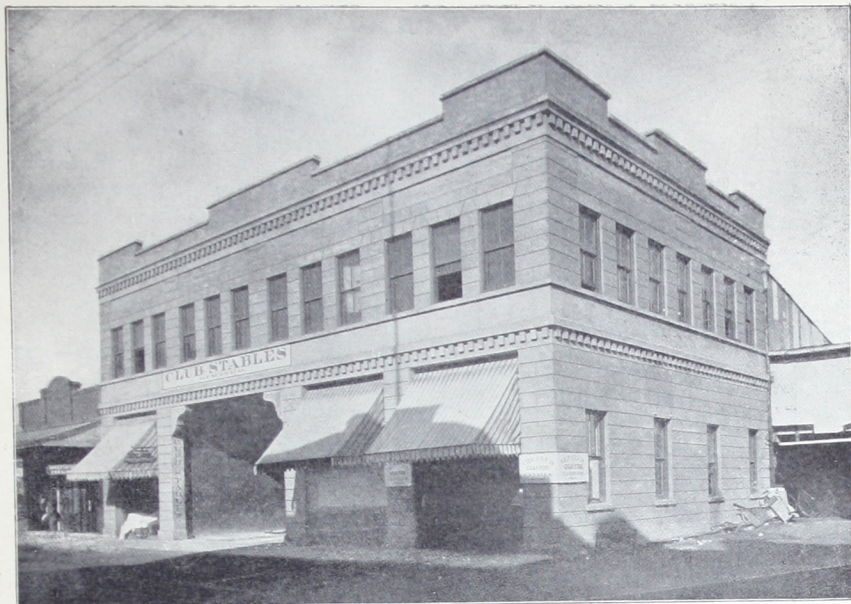




PUNAHOW PREPARATORY SCHOOL, HONOLULU, H. T.

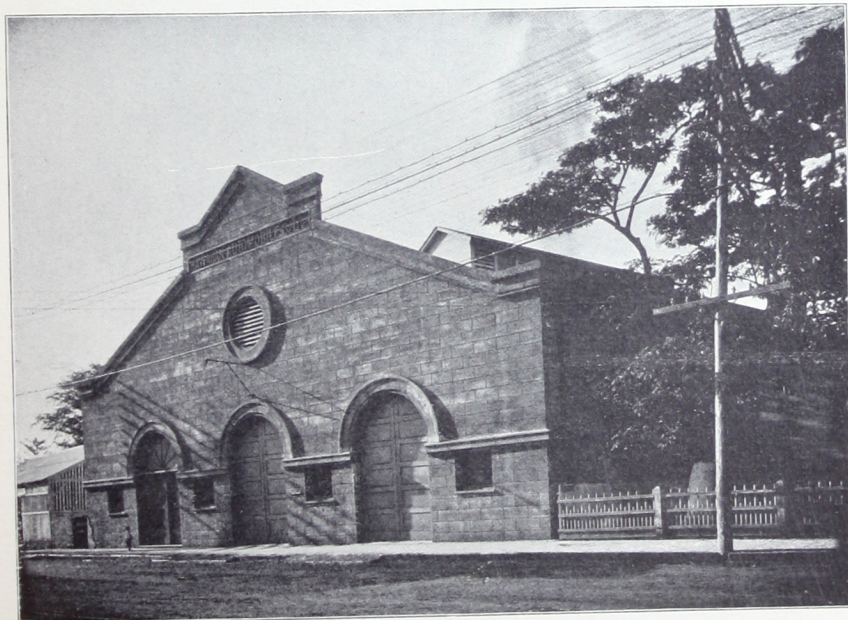
Ransome construction throughout. Built by the Concrete Construction Co., Ltd.





**CLUB STABLES, HONOLULU.**

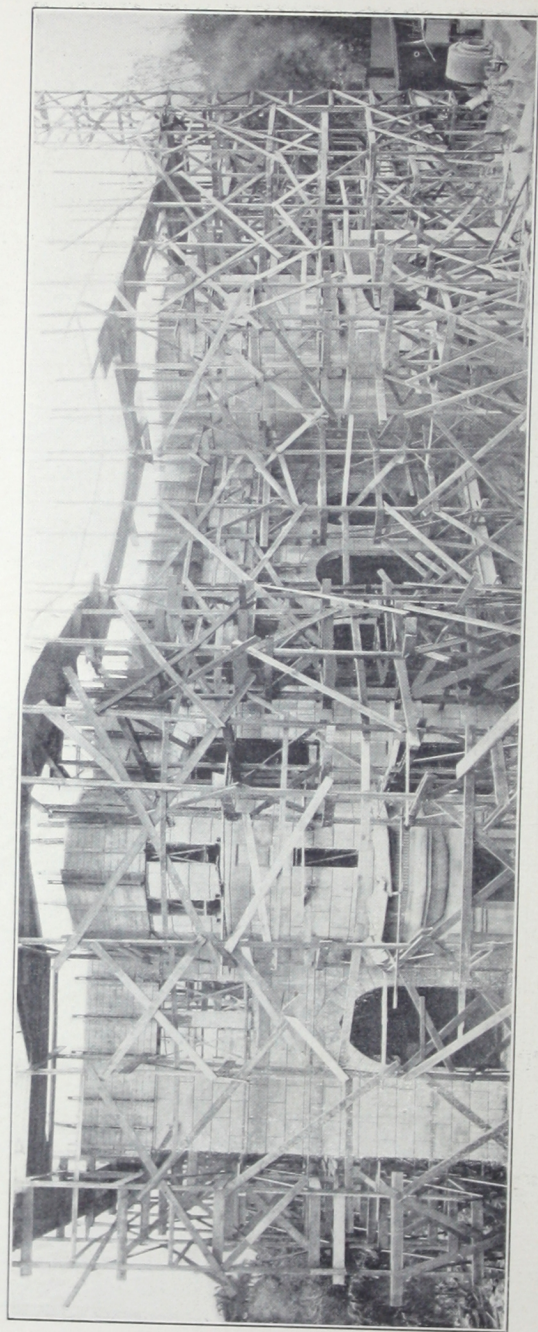
Entire construction concrete-steel. Ransome system.



**HAWAIIAN AUTOMOBILE CO., LTD., HONOLULU.**

Built by the Concrete Construction Co., Ltd., Honolulu, H. T.



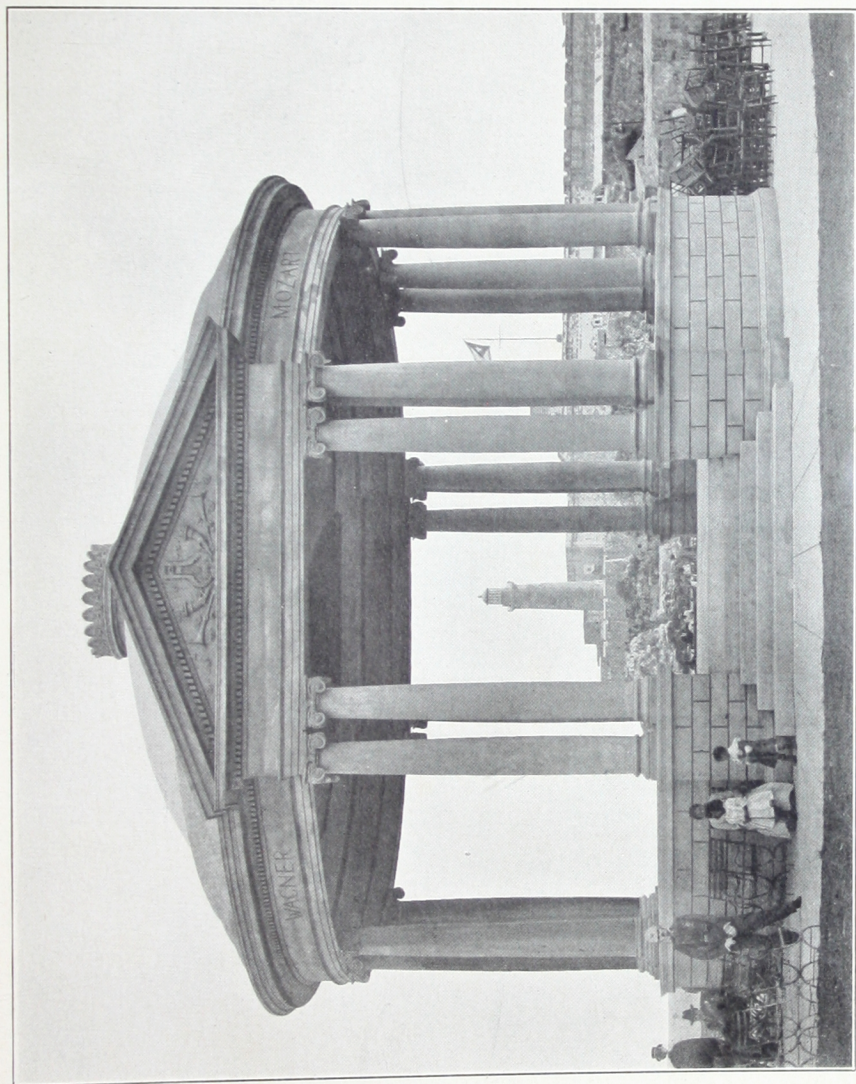


LAS DELICIAS,

RESIDENCE OF MRS. LA ABREU, HAVANA, CUBA.

Built entirely of concrete, Ransome system. By Chas. C. Converse.





**BAND STAND, HAVANA, CUBA.**  
Ransome system. Chas. C. Converse, Builder.











